HEAT SYNDROME DATA
FROM
SELECTED HOSPITAL RECORD SURVEY

U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE

Public Health Service

Washington, D.C.

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Contract No. OCD-OS-62-100, Subtask 1221A

prepared by
U. S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
Public Health Service Division of Health Mobilization

under contract with
DEPARTMENT OF DEFENSE, DEPARTMENT OF THE ARMY
OFFICE OF CIVIL DEFENSE
December 1965

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ABSTRACT

Statistical analysis of heat syndrome causes, both environmental and human factors, with preventive and alleviating suggestions for civil defense shelters and similar situations. Useful base for clinical evaluation, for physicians and other medical personnel in emergency situations.

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INTRODUCTION

The Department of Health, Education, and Welfare, Public Health Service, in consultation and cooperation with the Department of Defense, Office of Civil Defense, conducted under contract, a study of the environmental health phase of Medical Care in Shelters.

The request for the study came from the need to evaluate probable shelter environmental conditions and their effect on various types of the population assembled in an emergency.

This part of the study, as outlined in the contract, was divided into three parts covering the following items:

1. Determine incidence of acute, chronic, and incapacitating diseases that are affected within the population by the environment;

2. Survey of selected hospital admission records to determine incidence of heat stroke and heat exhaustion in order to determine the conditions of the environment and the physical status at time of occurrence;

3. State the physiological and clinical effects of environmental factors in quantitative terms and the relative contributions of each in a form which will guide planners as to significance of various combinations.

The titles and authors of the final reports of the three parts follow:

1. Shelter Population Health Status Study, Division of Health Mobilization, PHS, September 1965;

2. Heat Syndrome Data from Selected Hospital Record Survey, Division of Health Mobilization, PHS, September 1965;

3. Evaluation of Thermal Environment in Shelters, Douglas H. K. Lee, M.D. and Austin Henschel, Ph.D., Division of Occupational Health, PHS, August 1963.

The Selected Hospital Record Survey, providing the raw data for this heat syndrome study, was made under contract from the Division of Health Mobilization by James Meyers, M.D. and Mario A. Calonje, M.D., graduates of Louisiana State University, School of

Medicine, New Orleans. Presently Dr. Meyer is a radiologist in Louisville, Kentucky and Dr. Calonje is a member of the staff (radiology) of the Ochsner Clinic and Ochsner Foundation Hospital, New Orleans, Louisiana.

The purpose of the three-part study was to determine the extreme of environmental conditions which could develop in emergency shelters and in which both normal and sick people could survive for periods up to 14 days immediately postattack.

The objective of this phase, analysis of clinical record data, was to determine the ambient conditions and human factors of hospitalized heat syndrome cases.

This statistical evaluation is taken from a number of sources all of which are identified in the accompanying text. True copies of all source material, identified in the text and charts of this report, are in the research offices of the Office of Civil Defense, Department of the Army, OSA and the Division of Health Mobilization, Public Health Service, DHEW.

Permission was granted by the authors and publisher to quote from and refer to the monograph, Hot Climates, Man and His Heart, George E. Burch, M.D., Nicholas P. DePasquale, M.D., and Charles C. Thomas, Publisher, Springfield, Illinois 1962

Description of the four clinical syndromes due to a hot and humid climate, their differentiating characteristics, and the explanation of sensible and insensible heat are all taken from this authoritative monograph.

The analyst referred to this summary of more than twenty years study by the authors at Tulane University for the cause and significance of statistical facts revealed by the charting of environmental and human factors of heat syndrome cases.

It is reasonable for this report to concentrate on thermal aspects of heat syndromes with the hope it will add to the fundamental knowledge already learned of cause and effect.

The ultimate goal of the accumulated findings in these several related studies is a digest stating the clinical aspects indicated for the physicians and other medical personnel in emergency shelters or other similar stress situations.

SUMMARY

Findings from the analysis of data extracted from the Selected Hospital Record Survey are set forth in this report by a series of charts and brief supporting text.

The objective of the analysis, to determine the ambient conditions where stricken and to ascertain the physical status of the individual prior to developing heat syndrome, is recorded to the extent of facts available from raw data.

Unfortunately many factors considered to be contributory to heat syndrome were posted on comparatively few cases. The short hospital stay for most heat syndrome patients was probably one reason. A cursory review of the past history and days hospitalized columns of Chart J, p. 43, will show that a preponderance of individuals with a contributory history factor also spent more days in the hospital.

The investigators explained that on some of the initial case records reviewed, the actual time of attack was extracted, but later omitted, because it was felt that the temperature at that specific hour was not the sole temperature contributing to the malady, nor could it reflect the more meaningful cumulative effect of heat. Maximum and minimum temperatures for the day and date were recorded as were three timed-readings for relative humidity, but they were taken at different hours of the day than the temperature readings and could not be correlated.

The analysis of the syndrome cases from eight New Orleans hospitals shows a range in age from the very young to the elderly with a majority of 80% in the age bracket, 11-55 years. This majority is almost identically reflected in the 1962 civilian labor force of 82% in the age range from 14-55 years.

However, within these ages the breakdown by sex is by no means comparable. In this study 90% of the syndrome cases were males whereas in this portion of the labor force 65.5% were males.

One of the generalizations made by Dr. Burch indicated the possibility of greater incidence among males. He stated that, under similar environmental conditions, female subjects excreted considerably less sweat than did male subjects. Thus the depletion of salt was less, which would tend to increase female thermal capacity. Male and female subjects were given identical thermal tests.

The case statistics for the nine New Orleans hospitals and the New Orleans coroner's report, 'ppendix 1, would seem to support the theory that there are more deaths from heat syndrome among males than among females.

Many environmental conditions are considered to be contributory to heat syndrome cases. In this analysis of data from actual hospital cases, the place of residence, place stricken, maximum climatic temperature and humidity for the admission date, whether the individual was in or out of doors and whether he was engaged in extensive physical activity when stricken, have all been charted.

It was assumed by one authority that the heat syndrome cases in and near New Orleans were visitors, not residents, but this study very definitely discredits this assumption. The charted statistics show that 65% of the hospitalized cases were residents of New Orleans and that all cases were within a radius of approximately fifty miles of New Orleans when stricken.

In New Orleans, approximately 22% of the days each year have a miximal temperature of 90°F. or above, whereas only 0.2% of the days have a minimal temperature of 32°F. or below. The high temperatures are accompanied by a subtropic relative humidity and there is little or no relief from this climatic environment at night.

The number of cases in certain years was far greater than in others. For example, in seven of the 29 years charted there accrued 54% of the total cases from the eight New Orleans hospitals, Source I. In three of these same seven years, Louisiana State Charity Hospital in New Orleans, Source II, recorded 35% of their total cases in 22 years.

Chart G, p. 35, showing total cases by calendar months is very convincing regarding the factor, climatic heat. In the four peak-heat months of June, July, August and September, there occurred 88.5% of all cases from Source I. However, November and December were the only two months with no cases from 1934 1962.

The total cases in the several temperature ranges show a preponderance of heat syndrome when climatic temperatures were highest. From Source I, we found that 92.5% of all cases occurred on days having a maximum dry-bulb temperature of 85°F or above.

The subtropical humidity of New Orleans, together with the climatic heat, increases substantially the thermal stress for those whose work and manner of living do not offer periodic relief in an air-conditioned environment day or night.

Approximately 94% of all heat syndrome cases from Source I occurred on days when the maximum percentage of relative humidity registered 70 and above.

Exposure to a hot and humid environment may result in four clinical syndromes which are associated with disturbances in the heat-regulating mechanism or in the electrolyte balance, or in both, according to Dr. Burch.

The heat syndrome cases from Source I are classified in three of the four categories namely heat cramps, heat exhaustion, and heat stroke.

These syndromes are not only encountered in the subtropical and tropical climatic zones, but they also occur during the summer months in the temperate climatic zones. This fact is quite evident from the charts on "heat injuries" hospitalized in U.S. Army Medical Treatment Facilities, Appendix 2.

In many industrial fields the work is accomplished in boiler rooms, ships' holds, steel mills, iron foundries, and the like, where there are temperatures considerably higher than the climatic heat and with almost no movement of air. Then there are many types of labor which must be done with long hours of direct exposure to the sun. These conditions with the excessive physical exertion of the work definitely tend to increase the incidence of heat syndrome.

The analysis of Source I data shows very few cases, less than 0.7%, where the individual was not engaged in physical exertion and/or in the hot sun for an extensive period of time. Fifty percent of these cases occurred while outdoors and, it is reasonable to assume, exposed to direct sun for most of the workday.

There were four deaths in Source I data, three of which occurred in the "heat syndrome year" 1954, and all were in the peak-heat months of June and July. Source II data showed 15 deaths, all but one of which occurred in the peak-heat months of June, July, and August. These statistics further emphasize the significance of the prolonged, cumulative heat factor in heat syndrome cases.

Substantial relief and prevention, to some extent, of adverse effects from hot and humid climates may be effected by a few comparatively simple precautions.

The loss of large quantities of electrolytes in sweat can be avoided in normal man by supplementing the usual chloride intake, either by salting drinking water or taking salt tablets.

A slowing of pace, protection from sun, appropriate clothing, diet and air-conditioning or an available cooler environment for periods of the day or night would prevent many attacks.

Several limited studies have been added to this report. They include statistics on heat syndrome cases in Louisiana State Charity Hospital located in New Orleans. These data are identified in this report as Source II.

A special study was also made of records of the coroner's office of New Orleans regarding non-hospitalized, fatal heat syndrome cases. These data are referred to as Source III, Appendix 1.

Source IV, Appendix 2, is data on "heat injuries" submitted from the Department of the Army for the calendar years 1961 and 1962. These heat syndrome cases were hospitalized in Army Medical Treatment Facilities in the 48 contiguous States and the District of Columbia.

The statistics for both the hot and the temperate zones from Source IV support findings from Sources I and II regarding the peak-load months of June, July, and August. These statistics show that there were more than twice as many hospitalized heat syndrome cases from the hot zone than from the temperate zone army facilities.

A survey was made of the clinical records of heat syndrome cases hospitalized at Louisiana State Charity Hospital from 1942-1964. The study resulting from this survey by Kenneth Michael Laughlin, M.D. of Tulane University is submitted with this report as Appendix 3.

This study was undertaken to determine the factors that contribute to the failure of man's thermoregulatory mechanisms. The findings tabulated therein support the basic facts revealed by data analysis from Selected Hospital Records Survey.

Dr. Laughlin's paper, entitled Study of Heat Stress Disorders in New Orleans, covers approximately the same cases as Source II of this report. However, his study was made from Charity Hospital's clinical records for heat syndrome cases, whereas, the raw data for Source II findings are from patient record-room cards allowing no specific factors for comparison.

Source III cases, which recorded the sex, were all male and the seventh case was assumed to have been male. The four deaths from Source I were all males but from Source II the male deaths were in proportion to the total male cases.

The age range of Source III deaths was considerably lower than those of Sources I and II. The average age of coroner's cases, Source III, was 47 years, far below "60 years and over" considered to be age for greater incidence of heat syndrome.

CONCLUSIONS

"The importance of the influence of climate and weather on normal and diseased man needs no emphasis. Most of the inhabited areas of the world are hot for many weeks or months of the year. Man may escape disease, but he cannot entirely escape climate. Normal man is able to adapt to the most rigorous environmental conditions; however, aged or diseased man does not tolerate hot and humid environments and may even be killed by climatic stress."

This general and encompassing conclusion is a statement used to preface the authoritative monograph referred to a number of times in the text of this report for the significance of extracted statistics.

Studies of the influence of hot and humid environment on normal man have been comparatively few, and investigations of the influence of such environments on man with heart disease are almost nonexistent because of the obvious risk. No laboratory animal can serve as a model for man in climatic tests because man's thermal regulatory mechanisms are unique.

One means of learning more about environmental conditions and human factors contributing to heat syndromes is the detailed study of clinical charts of syndrome patients. But an even better means may be the investigation of heat syndrome cases as they occur and specific provision has been made for three such additional studies.

Contributory environmental conditions include temperature, humidity, air movement, radiant heat, clothing, noise, and proximity of persons. The more common human factors are age, sex, acclimatization, activity, physical fitness, diet, nervousness, and history of disease.

It would not be practicable to enlarge upon all of the stress factors and their many combinations even if the information were contained in the raw data, nor would it contribute substantially to the purpose of the study. The important effects, particularly those, which with least time, cost, and effort may be eliminated or alleviated, are conclusively revealed in the charts of this report. The significance of the combination of two or more principle factors is also revealed, as contributory to heat syndromes.

Heat syndrome occurs at all ages of man but with a large majority being stricken during the age span of years associated with work, and particularly physical labor. This analysis shows that almost all cases had been engaged in excessive physical exertion and fifty percent were working out of doors exposed to radiant heat when stricken.

It is stated by recognized authorities on the heat syndrome that the category, heat stroke, occurs primarily in persons "60 years of age or older." However, in the twenty-four "heat stroke" cases in this study of clinical records, Source I, only four were 60 years old or older and eighteen cases were under 40 years of age.

Certain generalities, reported from scientific tests seemed to be evident in these statistics also. One of these findings indicated there was no difference between the concentration of Na^{23} and Cl^{35} in the sweat of the Negro and Caucasian subjects tested. There was no difference in incidence of heat syndrome in the data from Charity Hospital, Source II, between the Negro and Caucasian as charted in this report.

A second finding by the same authority was that females sweat less and therefore may develop a greater capacity for climatic heat and have a lower incidence of heat syndromes. This too, seemed to be borne out by all data where the sex factor was available for comparison. This fact or conclusion has been determined to be a metabolic phenomenon.

The statistics show beyond doubt hat the period of greatest climatic stress in New Orleans is the summer. In the northern areas of this country, according to research findings, the periods of greatest climatic stress are during the cold months of the year and during sudden heat waves in the summer. However, the charts in this report that include cooler climates, show a preponderance of cases in the peak-heat months of June, July, August, and September.

According to one authority, acclimatization in man to a hot and humid environment, requires from several days to several weeks depending upon the state of health of the individual and upon his activity. However, even acclimatized, "normal" subjects often cannot establish a satisfactory steady physiologic state in hot and humid environments.

This fact is borne out by statistics from Source I, which show that all of the heat syndrome cases hospitalized in eight New Orleans hospitals were either residents of New Orleans or nearby, working in New Orleans or within a radius of fifty miles of that industrial center.

Immigrants to the tropics from cooler climatic areas may develop the syndrome of heat exhaustion if they fail to take proper precautions about suitable clothing, adequate rest, excessive eating, and inadequate liquid and salt. This conclusion is borne out by the experience of the Armed Forces.

Military recruit training posts, particularly the Army and Marine stations, report a high incidence of heat exhaustion during the first three weeks of training even in the most temperate geographic areas, despite the revised summer schedules.

It was concluded that some epidemiological factor other than climatic heat played a dominant role. Examination of case records revealed that sustained metabolic heat output in incompletely acclimatized trainees appeared to be the factor, which combined with environmental heat led to the excessive heat strain and high incidence of heat casualties. It is felt that uniform regulations based on a present "in practice model plan" would reduce casualties from heat syndrome.

In heat casualties, there is involved the individual with all of his environmental conditions and human factors considered contributory to heat syndromes. The importance of each factor and the interaction of multiple factors is recognized, but just how to prevent these casualties is not fully understood.

For the well and able-bodied, a slowing of pace, protection from sun, appropriate clothing, diet, air conditioning or an available cooler environment during periods of the day or night would prevent most attacks. Adequate space per individual and periods of quiet relieve stress on people of all ages. This human factor has been especially emphasized from pilot tests of emergency shelter occupancy.

A period of rest and recovery after any heat syndrome threat or attack will alleviate danger of a second incident.

There appears to be an essential relationship between insensible perspiration and heat production. Therefore, food which increases heat production also increases the rate of water loss from the body. This factor is important under all conditions of water shortage.

The loss of large quantities of electrolytes in sweat can result in serious illness. In normal man this difficulty can be avoided by supplementing the usual sodium chloride intake either by salting the drinking water or by taking salt tablets. An increase in volume of fluids in diet, if available, is also a preventive measure to the potential threat of heat stress.

From these data and the review of other heat syndrome studies, we conclude that many "normal" individuals, without past or present pathological contributory causes, may be victims of heat syndrome while working or exercising in a hot, humid climate and particularly in areas where there is no invigorating cool period at night nor great movement of air at any time.

This report on heat syndrome cases makes one more aware of the importance of weather and climate on the health, therefore the happiness of man. Man is affected both mentally and physically by climate and weather, and Dr. Burch contends that some diseases are almost totally under the influence of weather.

Man devotes a great deal of time, energy, and material means adjusting to climate and weather. It has been said that no interpretation of human history could be accurate if it disregarded the effect of weather and climate on human affairs.

This analysis presents a statistical evaluation of a number of factors that contributed to actually hospitalized syndrome cases. It may assist in predicting some of the probable effects on individuals subjected to the envisioned environment of emergency shelters and similar situations. It may also assist by indicating relief and prevention measures for heat syndromes through comparatively simple precautions in emergency planning.

ADDITIONAL STUDIES ON HEAT SYNDROME

Although no great incidence of heat syndrome was expected to be found in New Orleans, it was decided to conduct the Selected Hospital Record Survey there because so much research has been done in New Orleans on heat syndrome, especially at Tulane University.

A study similar to the one reported here is nearing completion under the title, Mortality and Morbidity During Hot Spells in Los Angeles and Orange Counties, California 1939-1963.

Another study to determine the effects of heat on elderly persons is underway at St. Petersburg, Florida. This study will also give data for a hot, humid climate. A similar study on elderly people is planned for Phoenix, Arizona, to determine comparable effects of the hot and dry climate.

Both the Selected Hospital Record Survey and the Los Angeles area survey mentioned above are retrospective epidemiological studies and hence do not give much desired information, particularly the physical and health status of heat syndrome cases prior to attack.

Prospective epidemiological studies were recommended in which heat syndrome cases would be investigated as they occur. Provisions for such studies have now been made in three cities which, in past years have experienced sudden heat waves. These investigations will be started immediately upon receipt of weather reports of sudden and abnormal temperature rise.

All of these investigations are supported by Office of Civil Defense, Department of the Army, OSA. The data obtained from them are expected to aid considerably in the evaluation of thermal environment in shelters and the effects of probable extremes on shelter occupants.

LIST OF CHARTS

Sources I and II

SELECTED HOSPITAL RECORD SURVEY

OF HEAT SYNDROME CASES

The purpose of the complete study, of which this report is one phase, is to determine the extreme of environmental conditions which could develop in fallout shelters, and in which both "normal" and sick people could survive for periods up to 14 days and still emerge in condition to contribute to the reconstruction of the community and the Nation.

A. Selected Hospital Record Survey

The objective of the hospital admission-record survey phase was to determine the conditions of the immediate environment where the patient was stricken, and to ascertain the physical status at the time of occurrence. This phase of the report concerns those human and environmental data which are considered to contribute to the incidence of heat syndrome.

1. Environmental conditions are temperature, humidity, place of residence, air movement, radiant heat, clothing, and approximation of persons.

2. Human factors include age, sex, race, activity, acclimatization, functional impairment, disease, hydration, diet, and normal variations.

B. Criteria for Record Survey

1. Investigators were contracted to conduct a survey of selected admission records to determine the incidence of heat stroke, heat exhaustion, and heat cramps in a number of private institutions and at least one public hospital. The usual contributory environmental conditions and human factors were to be tabulated for each case as well as any other data that would give information as to causes predisposing to the development of heat syndrome.

2. Where case records showed the date and time of occurrence, records of the United States Weather Bureau for place stricken would be examined for all probable meteorological causes including sunshine.

C. Clinical Heat Syndromes

Excessive exposure to a hot and humid climate may result in four clinical syndromes which are associated with disturbances in the heat-regulating mechanism or in electrolyte balance or in both. These syndromes are heat asthenia, heat cramps, heat exhaustion, and heat stroke.

1. Heat asthenia (calasthenia) refers to a syndrome which has probably been experienced by all inhabitants of the temperate and tropical climatic zones. Its manifestations are not distinctive and consist of easy fatigue, headache, mental and physical inefficiency, decrease in appetite, insomnia, and irritability. These symptoms are frequently associated with sweating, excessive pulse rate, and shallow breathing. This may not represent a disease but the patient is certainly "ill at ease." In patients who are ill, this added heat syndrome may produce symptoms of circulatory stress. It is especially important in this type of patient to recognize the early signs of calasthenia because of the increased susceptibility to heat exhaustion and heat stroke.

2. Heat cramps is associated with painful muscle spasms following muscular activity in a hot environment. Heat cramps represents the most common of the three syndromes considered to be diseased states associated with hot and humid climate.

People living in tropical climates reduce their muscular activity during the hot period of the day. This reduces heat production when heat elimination is most difficult. In certain industries, and in forced marches for soldiers, for example, heat production continues to rise.

This syndrome is more common in the young and vigorous than in the elderly because strenuous physical activity is usually necessary to produce heat cramps.

When environmental temperature exceeds body temperature, body heat can no longer be lost by radiation and must be lost through the evaporation of sweat. If subject is performing heavy physical work the load placed upon vaporization of sweat is greatly increased. High humidity impairs evaporation of sweat. Prolonged physical labor under these conditions increases loss of sodium and chloride ions in the sweat resulting in a decrease in the concentration of these electrolytes in the blood and tissues. When critically low levels of concentration are reached, heat cramps develop.

Symptoms are spasms of voluntary muscles, and contractions of flexor muscles in fingers first, then larger muscles in legs and abdominal wall. Severe pain accompanies these contractions. The pupils dilate with each muscle spasm, the patient may sweat profusely and the skin becomes cold and clammy.

The diagnosis of heat cramps depends upon the history of strenuous muscular exercise in hot environment associated with profuse sweating. The fact that the cramps are intermittent helps differentuate heat cramps from acute abdominal disease.

Mortality rate is nil if proper therapy is instituted. The patient should be moved to cool environment and sodium chloride, other electrolytes, and water replaced.

3. Heat exhaustion is characterized by profuse sweating, weakness, vertigo, pallor, low blood pressure, rapid pulse, a subnormal, normal, or slightly elevated temperature. Heat cramps may be associated with heat exhaustion.

Heat exhaustion is associated with prolonged periods of hot weather and is precipitated by excessive exposure to sun and physical exertion or both. Poor health, salt restriction, and lack of acclimatization are predisposing factors.

Heat exhaustion is not difficult to identify. Symptoms include weakness, malaise, profuse perspiration, nervousness, insomnia, vertigo, and headache. These symptoms precede the development of the syndrome by one or two days.

Therapy should be directed at once toward restoring the body temperature to normal since heat exhaustion progresses into heat stroke before death. Isotonic solutions of sodium chloride may be administered and are probably of value even if patient is not salt depleted. It is not necessary to administer the sodium chloride intravenously.

The response to therapy is usually fairly rapid. However, if it is not, underlying diseases such as circulatory shock should be considered.

4. Heat stroke is characterized by extremely high fever and profound coma and may be preceded by the symptoms of heat exhaustion. Heat stroke occurs primarily in people 60 years of age or older or in people with chronic illness

The disease may be more common in the temperate zones during severe and prolonged heat waves. Heat stroke is seen especially among persons working in a hot and humid environment where there is no air movement, such as mines, boiler rooms, large ships, and foundries.

The prodrumal symptoms consist of weakness, vertigo, nausea, headache, abdominal pain, typical of heat cramps, and mild heat exhaustion. There is usually a cessation of sweating shortly before the heat stroke. Prior to this there is excessive sweating. High body temperature, usually above $106^{\circ}F.$, and coma or mental confusion mark the acute phase of heat stroke.

Heat stroke is a medical emergency and once diagnosis is made, treatment must not be delayed even momentarily. Reducing body temperature is the first objective, preferably by iced bath.

The maintenance of lower temperature and the return of sweating usually indicate that the patient will survive though the mortality rate is probably greater than 50%.

D. Differentiating Characteristics of Heat Syndromes

Heat cramps is the mildest of the definite syndromes associated with excessive exposure to a hot and humid environment. The cardiovascular and thermo-regulatory systems are intact. The patient has an essentially normal blood pressure and sweats profusely, the skin being warm and moist. The body temperature is only slightly elevated or is normal.

In heat exhaustion there is a loss of vasomotor control of the blood vessels and circulatory shock. The skin is pale and cold. Since the patient sweats, the skin is moist (cold and clammy). The pulse is thready and the blood pressure is low. The body temperature is subnormal or normal.

In heat stroke there is a loss of thermo-regulatory control and sweating ceases. The skin is flushed, hot and dry, the pulse is bounding and full, and the blood pressure is elevated. The body temperature is markedly elevated. Delirium or coma is present.

E. Sensible and Insensible Heat

Water which is lost from the body independent of sweat gland activity is considered as insensible perspiration and water lost from the body due to sweat gland activity, whether it is visible on the surface of the body or not, is considered sensible perspiration. That portion of the sensible perspiration which is not visible as moisture on the surface of the body because of prompt evaporation would be referred to as occult sweat.

There is an essentially linear or equal relationship between insensible perspiration and heat production. Therefore, those foods which increase heat production will also increase the rate of water loss from the body. Protein with its high specific dynamic action (SDA) will greatly increase water loss by diffusion. The importance of these factors to survival under conditions of water shortage and deprivation is obvious.

EIGHT NEW ORLEANS HOSPITALS

SOURCE I

A. Heat Syndrome Case Selection

To obtain sufficient cases of heat exhaustion, heat stroke, and related clinical syndrome for analysis, it was necessary for the investigators to review approximately 450 individual charts, dated from 1934 to 1962, in eight New Orleans hospitals. There were, for example, 276 individual charts in which the admission diagnosis indicated heat syndrome but neither the working diagnosis nor the discharge diagnosis confirmed this finding after application of severe diagnostic criteria.

But still another necessity for screening the many charts was the fact that the investigators making the survey were following and applying the exacting definitions for the several categories of the heat syndrome so ably set forth in the before-mentioned monograph.

It was decided to conduct this study in New Orleans because a great deal of research on the effects of heat on man has been performed there, especially at Tulane University.

B. Analysis of Heat Syndrome Data

The analyst has selected and tabulated facts from data sheets covering the 182 heat syndrome cases. Upon close study it was found that the discharge diagnosis discounted or denied heat syndrome in eight of these cases, therefore the total used is 174 cases from the eight hospitals named in Chart A, p. 29.

Data from the ninth New Orleans hospital, State of Louisiana Charity Hospital, were not obtained from the clinical records but from a summary-type, record room card, which grouped all heat syndromes under one category, namely, "heat stroke". Therefore, the data from Charity Hospital were not readily comparable under a number of factors with data from the other eight hospitals. For this reason, separate charts for Charity Hospital portray the data submitted. Comparison of several factors from Source I and Source II is made later in this report.

In order to make the references in this text more simple, data from the eight New Orleans hospitals listed in Chart A, p. 29, are identified Source I, and data from the ninth New Orleans facility, Charity Hospital, Source II. The charts of statistical data bear corresponding identification.

The human factors submitted for the total heat syndrome cases from Source I are tabulated, for the most part, in Chart B, p. 30. The death statistics from both sources are compared in Chart Q, p. 54.

The ages of all cases and for each sex extended from the very young to the elderly. The great majority, or 82%, of the total, both sexes, was in the age range from 11 to 55 years. This majority is almost identically reflected in the 1962 civilian labor force of 82% in the age range from 14 to 55 years. However, within these ages the breakdown by sex is by no means comparable. Ninety percent of the syndrome cases were males, whereas in this portion of the labor force 65.5% were males.*

It is interesting to note here one of the generalizations reported from identical tests for males and females for rate of sweating and the concentration of sweat. Under similar environmental conditions, female subjects excreted considerably less sweat than did male subjects. Thus the depletion of salt from the system was less. This would tend to increase the female thermal capacity and in so doing keep the incidence of heat syndrome amongst females lower than amongst males. These data support the above test report and resultant theory.

Four of the eight hospitals, Source I, admitted Caucasians only, one admitted Negroes only, and the other three admitted both races. Because there were only seven Negro cases in the total of 174, the race factor was not calculated for Source I, but is noted for Charity Hospital, Source II.

Many environmental conditions are considered to contribute to heat syndrome cases. Their physiological and clinical effects will be reported in another phase of this overall research subject.

In this phase of the study, a number of the contributing factors from actual hospitalized cases has been charted. Chart C, p. 31, shows the place of residence, place stricken, maximum temperature, and whether the individual was in or out of doors when attack occurred.

It was assumed by one authority that the heat syndrome cases in and near New Orleans were visitors, not residents, but this study very definitely discredits that assumption. It will be noted on Charts D and E, pp. 36, 37, that 156, or 90% were residents of Louisiana. The few, 17, with residence in other States, or in countries other than the United States, were living in or near New Orleans when hospitalized.

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* Department of Labor, Bureau Labor Statistics, Special Labor Report #31, May 1963.

As a matter of fact, all cases occurred within a radius of approximately fifty miles of New Orleans.

Acclimatization in man to a hot and humid environment requires from several days to several weeks, depending upon the state of health of the individual and upon his activity. However, even acclimatized, normal subjects often cannot establish a satisfactory, steady physiologic state in hot and humid environments.

The investigators, who conducted the survey of selected hospital records for heat syndrome cases, also examined the Weather Bureau records to ascertain the corresponding temperature and humidity of patient admission-date in the city where stricken.

The relative humidity was also obtained for the day and date stricken for each case. The investigators stated that the humidity varies inversely with the temperature so they determined an additional weather factor, the "dew point." This figure stays relatively constant while the humidity varies greatly. Limited data on this weather factor are in Chart H, p. 40.

Maximum temperatures for the day the individual was stricken are given in Chart C, p. 31. An explanation received with hospital record data noted that in some of the initial cases the time at which the patient became ill is recorded. This was later omitted because the investigators felt that the temperature at that specific hour was not really the sole temperature responsible for causing the malady and did not reflect the cumulative effect of heat. The peak temperature usually occurs near noon and continues for one or two hours after midday.

In New Orleans, approximately 22% of the days each year have a maximal temperature of 90°F. or above, whereas only 0.2% of the days have a minimal temperature of 32°F., or below. The high temperatures are accompanied by intense humidity and, in New Orleans subtropic climate, there is little or no relief from this same environment at night. Thus the hot and humid summer weather of this city constitutes a climatic stress.

The heat syndrome cases analyzed, cover the years 1934-1962 inclusive, and in Chart F, p. 38, the total number of cases for each calendar year is given. It will be noted that in the seven years - 1951, 1953, 1954, 1957, 1959, 1960, and 1962 - there were from 10 to 16 cases for each year; whereas the average per year for the span of 29 years was 6 cases. The total for these seven years was 94, or 54% of 174 cases in 29 years.

If the weather pattern were to be reviewed for those seven years, it might be found that the heat wave came on suddenly or that it was longer and more intense than usual. Both of these climatic variations contribute to this syndrome.

Chart G, p.39, which shows the total cases for calendar months, is easily read and very convincing as to the factor, climatic heat. There were 154, or 86.5% of all cases in the four peak-heat months - June, July, August and September, but only November and December were without cases.

Because the period of greatest climatic stress in New Orleans is the summer, it is in that season that the greatest number of acute coronary occlusions occur. In the northern areas of this country the period of greatest climatic stress is during the cold months of the year so that the greatest incidence of myocardial infarction is during the winter.

The totals of cases in the several temperature ranges in Chart H, p.40, show the preponderance of heat syndrome when the temperatures were 85°F. and above. The temperatures in this chart are maximum outdoor dry-bulb temperatures for the 24-hour day. In a number of cases analyzed, however, the individuals were laboring in factory and other indoor work environments recording temperatures up to 120°F.

Four heat syndrome categories were each described in detail previously. Three of these, heat cramps, heat prostration, and heat stroke are considered to be true pathological conditions associated with hot and humid climates. These three are used for the analysis of the heat syndrome cases in this study.

Heat syndromes are not encountered exclusively in subtropical and tropical climatic zones. Heat waves and extreme cold of temperate climatic zones, as well as certain industrial working conditions, tend to make them more prevalent in the temperate than in the tropical zones.

Heat cramps is the most common of the three syndromes. It is considered to be more prevalent in the young and vigorous than in the elderly or debilitated because strenuous physical activity is usually necessary to produce heat cramps.

The data presented for analysis on heat syndromes have fewer heat cramp cases than for heat prostration or heat stroke. This may be because therapy was administered elsewhere. A cool environment, proper rest, replacement of sodium chloride or other electrolytes, adequate water, and care not to repeat the incident by known causes, are all that is necessary. There are very few deaths from heat cramps alone.

Preventive measures also include daily supplementation of salt, either by salt tablets or by salting drinking water. The heat syndrome is obviously more serious for individuals with conditions which restrict salt intake.

The age range of the eleven heat cramp cases is 17 to 57 years and, with the exception of one 48 and one 57, might be called "young". There is no doubt, however, about the activity or labor engaged in being "vigorous". This activity ranged from football playing, a 17-year-old youth, to boiler work, a 57-year-old man.

Heat exhaustion or heat collapse is associated with prolonged periods of hot weather, and is brought about not only by exposure to the sun, but also by excessive physical exertion, or both, during hot weather. These particular causes of heat exhaustion resemble those of heat cramps. It is reported that in military establishments located in tropical or subtropical areas, heat exhaustion is one of the most common causes for hospitalization. There were 137, or approximately 80%, of all cases from Source I in this category as shown in Chart I, p. 41.

Heat exhaustion is not difficult to identify because specific symptoms precede the syndrome by one or two days. If the individual does not heed these symptoms and fails to stop the physical exertion and enter a cool environment, the symptoms increase in severity and kind, and death may occur or he may develop the highly fatal state of heat stroke. Studies show that heat exhaustion usually progresses to heat stroke before death occurs. Response to proper therapy for heat exhaustion is usually fairly rapid and complete, but if recovery is inadequate, the probable presence of other underlying diseases should be considered.

Heat stroke, or "sun stroke", is charecterized by extreme fever and coma and may be preceded by heat exhaustion symptoms as stated above. The syndrome category Chart I, p. 41, shows a total of 24 heat stroke cases or 14% of the total.

In his detailed and authoritative identification of the three categories of heat syndrome used here, Dr. Burch states that heat stroke occurs primarily in people 60 years of age or older or in people with chronic, debilitating illnesses. Heat stroke also occurs among persons working in a hot and humid environment in which there is no air movement, such as mines, boiler rooms, holds of ships, and in foundries.

The age span of 23 of the 24 heat stroke cases, with age recorded, is 3 to 77 years, but only four of these are 60 years or over. Eighteen cases are under 40 years, and the median is 25 years. These figures then do not support the "60 years and over" statement quoted previously. However, all were definitely living in a subtropic climate of heat and corresponding humidity.

The occupation or activity at time of attack was either in the sun or in jobs and work environments similar to those named before. The recorded heat in some of these occupational environments was considerably greater than the maximal climatic temperature. For example, one industry registered 120°F. in a specific manual labor area where several men were stricken.

Heat stroke is considered to be a medical emergency and once the diagnosis is made, treatment must not be delayed even momentarily. The treatment is directed toward reducing the body temperature and is a complicated procedure which would be difficult to practice in a shelter. The individual case history Chart J, p. 42, shows; the length of time each patient was hospitalized, past history, including previous incidence of heat syndrome, heart or lung conditions, sun exposure and/or physical exertion, and if the patient's treatment included intravenous saline solution.

The several conditions referred to under past history are not only contributory to a heat syndrome, but are conducive to an individual succumbing at a much lower temperature and with little or no excess physical exertion.

A cursory review of <u>past history</u> and <u>days hospitalized</u> columns of Chart J, p. 42, will show that a preponderance of individuals with a contributory history factor also spent more days in the hospital. Since there were only 12 cases that did not show sun exposure and/or physical exertion, one can readily see the part these factors play in heat syndrome cases.

It is interesting to conjecture to what extent heat was a contributing factor to many others hospitalized, though they were not designated at the time of discharge as heat syndrome cases. Out of the 450 clinical records that were reviewed, 174 proved to be authentic cases of heat syndrome. Undoubtedly, heat was a contributing factor to the condition of the remaining 276 clinical cases whose records showed an admission diagnosis of heat syndrome but heat syndrome was not designated at time of discharge.

Because intravenous therapy was administered to 112, or 64% of the total cases, this factor is also tabulated. This therapy may indicate in some measure the seriousness of the patient's condition and too, the treatment in part now given to heat syndrome cases. The present supplies and equipment stocked by the Federal Government in public fallout shelters do not include the items needed for intravenous therapy. However, these items may be available from other sources.

There seems to be some question regarding the great tendency to give saline solutions to patients with heat stroke. Dr. Burch states: "The venous pressure is usually not elevated in heat stroke. However, the over-zealous administration of intravenous fluids may precipitate pulmonary edema, especially in elderly patients with poor cardiac reserve........Intravenous fluids should be administered cautiously in elderly or debilitated patients."

The crude death rate of 174 heat syndrome cases in Source I was 2+%, or 4 cases, Chart K, p. 48. These were all white males 40 to 79 years old. Each had been exposed to very high climatic temperatures ranging from 90° - 102°F., and possibly higher indoor temperature with no circulation of air. The movement of air is one of the most important means of alleviating the stress caused by an extreme environmental heat situation, either indoors or outdoors.

LOUISIANA STATE CHARITY HOSPITAL

SOURCE II

A. Record Card Data

The heat syndrome case data submitted, upon request, from Charity Hospital were abstracted from record room cards instead of the patient's clinical record as in Source I.

In this data all patients, hospitalized for heat induced syndromes from 1942 - 1963, were classified as "heat stroke" cases. It is understandable that many of the lighter cases may have been treated as outpatients. But it is known from a later report, Appendix 3, that the clinical records placed these heat stress disorders in the clinical heat syndromes of cramps, exhaustion, and stroke.

B. Data Analysis

The data submitted from Charity Hospital contain several human factors on each heat syndrome case, namely: age, sex, race, and whether or not the patient survived.

Because this hospital cared for the sick and injured resident in Louisiana, and particularly from the metropolitan area of New Orleans, it would follow that they were also subjected to the same general occupational, domestic, and recreational environment hazards which contribute so substantially to heat syndrome.

The first chart for this hospital, L, p. 49, tabulates age, sex, and race. The race division in these cases is approximately equal, as is the sex division within the races.

Except in the colored male cases, there is no real majority in the age span of 11-55 years. It will be recalled that 82% of the cases of the other eight New Orleans hospitals fell within this age span. Instead, the heat syndrome cases of Charity Hospital seem to occur without emphasis at all ages, in both races, and amongst both sexes.

The crude and specific death rates are tabulated on Charts O and P, pp. 52 and 53. The crude death rate for Source II was 16-%, or 15 cases. These covered an age range of 7-85 years, with an average age of 56.5 years, not an elderly age according to current statistics. Two-thirds of the deceased were males, and 11, or 73%, of the deaths were white patients, even though the heat syndrome cases in the hospital were evenly divided racewise.

It was mentioned earlier in this report that certain generalities had been drawn from the tests reported in the monograph by Dr. Burch. This finding, in the chapter on Sensible and Insensible Water Loss, indicated there was no difference between the concentration of Na^{23} and Cl^{35} in the sweat of the Negro and white subjects tested. But, as stated before, the conclusion under sweating was that the difference in this particular was found to be between the sexes. The human factor statistics developed from Source II data seem to support these race and sex generalities.

The year and month are the only two environmental conditions available from Source II cases. Charts M and N, pp. 50 and 51 show these data.

The place of residence and place stricken were not given for Source II cases, but these individuals were assumed to be either natives or residents of Louisiana. They were, then, subjected to the same climatic conditions as were the patients in Source I.

The peak heat months are June, July, August and September in this subtropic climate of Louisiana's gulf area. At Source II, 82 or 86%, of total cases, 95, occurred during these months having the highest climatic temperatures. The same months had the highest number of cases, 154 or 88.5%, of the total 174 in Source I.

There seem also to be peak years for heat syndrome cases from Source II. The years 1942, 1944, and 1951 each have nine or more cases, whereas the remaining 51 cases are spread throughout the span 1942-1963. The total for the three years was 44, or 46%, of the total cases for 21 years at Charity Hospital.

It will be noted that no cases are recorded for five of these years - 1945, 1946, 1947, 1949 and 1959. The records for Source I do not follow this pattern but had cases in those years as follows: 1945 - 5; 1946 - 1; 1947 - 0; 1949 - 3; and 1959 - 13. A comparison between the two Sources by years can be seen in Chart R, p. .

The Chart M, p. 50, and, more particularly, Chart N, p. 51, show the total number of cases in each calendar month of the years 1942 - 1963. There were no heat syndrome cases at Source II hospital during the months of January and November during these years, as compared with no cases in November and December at Source I hospitals.

COMPARISON OF DATA

SOURCE I AND SOURCE II

The statistics of all nine hospitals could not be combined on charts for reasons previously given, but certain factors provided from both Source I and Source II can be compared. The comparable human factors available are age, race, sex and deaths.

The average age of the heat syndrome cases in Source I was 38 years, while the average age for the cases in Source II was 45 years. Though there was a difference of 7 years, or 18%, in these age-averages of syndrome cases, in the fatal cases there was only six months difference in average age. The death cases in Source I averaged 57 years and the death cases in Source II data averaged 56.5 years, Chart Q, p. 54.

Eighty per cent of all cases in Source I were in the age span 11-55 years, Chart B, p. 30, and only 61% of all cases at Source II were in this same age span, Chart L, p. 49.

The sex data on these cases from Source I showed a majority of 75% to be males in the 11-55 age span, while in Source II, 54% of the males were in that age span.

Half or 50% of the female cases in Source II, both races, were in the age span 11-55 years, whereas in Source I, 13 or 72% of the 18 female cases were in this age span. Ninety per cent of the total cases in Source I were male and in Source II the male cases were 79% of the total.

There were only seven Negro cases in the total 174 cases in Source I, and therefore there is no basis for comparison by race between the two Sources of hospitalized heat syndrome cases.

The crude death rate was considerably greater for Source II than for Source I. Source II had 15 deaths, or approximately 17% of 95 cases, whereas Source I lost 4 patients, or 2+%, out of a total of 174 cases. Was this because Charity Hospital, Source II, is the principal hospital for indigent sick people in New Orleans, or because the patients were older? Were they hospitalized after their condition became more serious?

The available specific environmental conditions common to all nine hospitals are place of attack, and the year and month stricken. However, the ambient heat and humidity, day and night, can be assumed to have been the same for all due to the subtropic climatic conditions of Louisiana. A greater number of cases occurred in the metropolitan area of New Orleans no doubt because industry, with its additional thermal hazards, is centered there.

Three of the four deaths in the eight New Orleans hospitals, Source I, occurred in 1954 and all were in the peak heat months of June and July.

The 15 deaths in Charity Hospital, Source II, occurred in six of the 21 years covered, and all but one in the peak heat months of June, July, and August. There is a detailed comparison of the deaths from both Sources in Chart Q, p. 54.

A span of years common to both Source I and Source II data is 1942 to 1962, inclusive. During these 21 years, Source I had 156 heat syndrome cases and Source II had a total of 94. Details are posted on Chart R, p. 55.

Four of these years-1951, 1952, 1953, and 1954 again show case load and doubtless peak heat years. Source I had 48 cases or 37.7% of total in these four of 21 years and Source II had 39 cases or 41.5% of their total in the same four of 21 years.

If climatological data were studied for these specific years, the relative strain posed by the temperature-humidity index would again reveal the significance of weather to heat syndromes, clinical states resulting from exposure to hot and humid environments.

CHART A

NUMBER OF HEAT SYNDROME CASES IN EACH HOSPITAL

Source I - 8 New Orleans Hospitals

	Hospital Name	Symbol	*Race	No. of Cases
1.	Touro Infirmary	T	Caucasian	107
2.	Hotel Dieu Sisters Hospital	HD	Caucasian	21
3.	Mercy Hospital	M	Caucasian	16
4.	Southern Baptist Hospital	B	Caucasian	10
5.	Flint Goodrich Hospital	I	Negro	6
6.	U.S. Public Health Service Hospital	P	Caucasian	6
7.	West Jefferson General	W	Negro and Caucasian	3
8.	Ochsner Foundation	O	Negro and Caucasian	5
			Total Cases	174

*Hospitals numbers 1, 2, 3, and 4 admit Caucasians only.

Hospital number 5 admits Negroes only.

Hospitals numbers 6, 7, and 8 admit both races.

No Negro cases were reported from number 6.

CHART B

AGE GROUP-RACE-SEX

Source 1

Age Group	WM	WF	CM	CF	Totals by Age Group
Under 1 yr.	0	1	0	0	1
1-10	2	3	0	0	5
11-20	19	1	0	0	20
21-25	17	1	0	0	18
26-30	13	1	0	0	14
31-35	13	3	0	0	16
36-40	20	1	1	0	22
41-45	10	3	2	1	16
46-50	18	2	2	0	22
51-55	12	0	0	0	12
56-60	5	0	1	0	6
61-65	9	0	0	0	9
66-70	3	0	0	0	3
71-75	2	0	0	0	2
76-80	2	1	0	0	3
81-85	0	0	0	0	0
86-over	1	0	0	0	1
Not Known	-	-	-	-	4
Totals	146	17	6	1	174

Overall Age Range: 11 Months to 86 Years
Male Age Range : 5 Years to 86 Years
Female Age Range : 11 Months to 78 Years

Age Factors in Total Cases (170)

	Age Span
140 or 82% of total cases are - -	11 - 55
122 or 71.7% of total cases are W.M.	11 - 55
122 or 83.5% of W.M. cases are -	11 - 55
12 or 70.6% of W.F. cases are -	11 - 55
7 or 4% of total cases non-white:	Not calculated.

CHART C

INDIVIDUAL SYNDROME CASE CHART

Environmental Temperature,
Place of Residence, Place Stricken,
and Whether Indoors or Outdoors

Source I

Case	*Max.F. Temp.	In	Out	Place of Residence	Place Stricken
1	91		x	New Orleans, La.	New Orleans
2	90	x		"	"
3	90	x		Westwego, La.	Westwego, La.
4	78	x		Chalmette, La.	Chalmette, La.
5	92	x		New Orleans,La.	New Orleans
-					
7	86	x		"	"
8	86		x	"	"
9	93		x	"	"
10	75	x		"	"
11	93		x	"	"
12	96	-	-	Ama, La.	Ama, La.
13	92	x		New Orleans,La.	New Orleans
14	92		x	"	"
15	96		x	"	"
16	90		x	"	"
17	96		x	"	"
18	94	x		"	"
19	91	x		"	"
20	94	x		"	"
21	95		x	"	"
22	88		x	"	"
23	90		x	Picayune,Miss.	"
24	83	x		New Orleans,La.	New Orleans
25	93		x	"	"
26	102	x		"	"
27	96	x		"	"
28	91		x	"	"
29	95	x		"	"
30	97		x	Westwego, La.	Westwego, La.
31	89	x		New Orleans,La.	New Orleans
32	90	x		"	"
33	84	x		"	"
34	89	x		Westwego, La.	Westwego, La.

*Maximum dry-bulb climatic temperature for 24-hour day in city where stricken.

INDIVIDUAL SYNDROME CASE CHART (cont'd)

Case	Max.F. Temp.	In	Out	Place of Residence	Place Stricken
*35	120	x		Hammond, La.	New Orleans
36	89		x	New Orleans	"
37	94	x		"	"
38	93		x	"	"
39	9[illegible]	x		Latin America	"
40	91	x		"	"
41	90	x		Slidell, La.	"
42	87	x		New Orleans	"
43	94		x	Nashville, Tenn.	"
44	89	x		New Orleans	Chalmette,La.
45	88	x		"	New Orleans
46	90		x	Jefferson Parish, La.	Jefferson Parish, La.
47	92		x	Marrero, La.	Sulfur, La.
48	90		x	New Orleans	New Orleans
49	87		x	Metairie,La.	Metaire,La.
50	77		x	New Orleans	New Orleans
51	92	x		Poydras, La.	"
52	92		x	Metairie,La.	"
53	93	x		Chalmette,La.	"
54	86	-	-	Kenner, La.	Kenner, La.
55	91	-	-	New Orleans	New Orleans
56	98		x	"	"
57	92		x	Buras, La.	"
58	87	x		New Orleans	"
59	87		x	Metairie, La.	Metairie,La.
60	92		x	New Orleans	New Orleans
61	94	x		Turkey	"
62	91		x	Metairie, La.	Metairie,La.
63	89	-	-	New Orleans	New Orleans
64	89	x		Chalmette,La.	Chalmette,La.
65	90		x	New Orleans	New Orleans
66	95		x	"	"
67	91		x	"	"
68	88	x		"	"
69	91	x		Italy	"
-					
71	93	-	-	Metairie, La.	Metairie,La.
72	87		x	New Orleans	New Orleans
73	90		x	"	"

*Temperature 120° F. in smelting pot room.

INDIVIDUAL SYNDROME CASE CHART (cont'd)

Case	Max.F. Temp.	In	Out	Place of Residence	Place Stricken
74	91		x	Not Stated	Not Stated
75	93	-	-	New Orleans	New Orleans
76	94	x		New Orleans	"
77	98	x		"	"
78	99	x		"	"
79	93	x		"	"
*80	74	x		Kenner, La.	Chalmette,La.
81	93	x		New Orleans	"
82	90	x		"	New Orleans
83	87		x	"	Chalmette,La.
-					
85	93		x	"	"
86	94		x	Springfield,La.	Springfield
87	83		x	New Orleans	New Orleans
-					
89	86	x		"	"
90	86	-	-	"	"
91	87	x		"	"
92	94	x		"	"
93	102	x		"	"
94	92	x		"	"
95	97		x	"	"
96	91		x	New Orleans	New Orleans
97	94	x		"	"
98	90	x		"	"
99	82		x	Bogalusa, La.	Bogalusa,La.
100	87		x	Arabi, La.	New Orleans
101	98	x		Carriere,Miss.	Carriere,M.
102	94	x		New Orleans	Jefferson Par.La.
103	92	x		St.Bernard,La.	New Orleans
104	88	-	-	New Orleans	"
105	92		x	"	"
106	94		x	"	"
107	91	x		Chalmette,La.	Chalmette,La.
108	93	x		New Orleans	New Orleans
109	90	x		Harvey, La.	"
110	94	x		New Orleans	"
-					
112	95		x	Destrahan,La.	Destrahan,La.

*Probably hotter in pot room where stricken, see case #35.

INDIVIDUAL SYNDROME CASE CHART (cont'd)

Case	Max.F. Temp.	In	Out	Place of Residence	Place Stricken
113	78	x		Amite, La.	Amite, La.
114	93	x		New Orleans	New Orleans
115	92		x	Alga, La.	Alga, La.
116	93	x		Ponchatoula,La.	New Orleans
117	96	x		New Orleans	"
-					
119	97		x	"	"
120	70	x		Slidell, La.	"
121	91		x	Delacroix I.La.	Delacroix I.
122	90	-	-	New Orleans	New Orleans
123	93	x		Manchester,Pa.	"
124	90		x	New Orleans	"
125	89		x	Norway	"
126	94	x		Greece	"
127	94	x		Mobile, Ala.	Mobile, Ala.
128	89		x	Covington,La.	New Orleans
129	97		x	Gretna, La.	Gretna, La.
130	86		x	Marrero,La.	Marrero,La.
131	94		x	New Orleans,	New Orleans
-					
133	92		x	"	"
134	92	x		"	"
135	90	x		"	"
136	92	-	-	New Orleans	"
137	89		x	"	"
-					
139	94	x		"	"
140	92		x	"	"
141	96	x		"	"
142	90		x	"	"
143	89		x	"	"
145	94		x	Mobile, Ala.	"
146	92		x	New Orleans	"
147	92		x	"	"
148	95	-	-	"	"
149	90	x		"	"
150	90	x		Gretna, La.	"
151	89		x	Wisconsin	"

INDIVIDUAL SYNDROME CASE CHART (cont'd)

Case	Max.F. Temp.	In	Out	Place of Residence	Place Stricken
152	90	-	-	New Orleans, La.	New Orleans
153	94		x	"	"
154	92		x	Canada	"
155	93		x	New Orleans	"
156	95		x	Tampa,Fla.	"
157	91		x	New Orleans	"
158	96		x	Morgan City,La.	Morgan City
159	92	x		New Orleans	New Orleans
160	94	-	-	Baton Rouge,La.	Baton Rouge
161	91		x	New Orleans	New Orleans
162	93		x	"	"
163	92		x	"	"
164	93	x		"	"
165	93		x	Gretna, La.	"
*166	74	x		Kenner, La.	"
**167	93	x		New Orleans	"
168	99	x		"	"
169	94	x		"	"
170	93	x		France	"
171	91		x	Harvey, La.	Harvey,La.
172	90		x	Texas	New Orleans
173	90		x	New Orleans	"
174	93		x	"	"
175	91	-	-	"	"
176	87	x		"	"
177	95	x		Sulfur, La.	Sulfur, La.
178	80		x	New Orleans	New Orleans
179	86	x		"	"
180	92	-	-	"	"
181	93		x	Norway	"
182	89		x	New Orleans	"

*Probably hotter in pot room - see cases 35 and 80.
**Temperature in tunnel where stricken 100° F.

Total cases with these factors: 174
Cases stricken indoors: 80
Cases stricken outdoors: 79
Not known: 15
No percentage given, division obvious.

CHART D

I. CASES FROM LOUISIANA, EXCLUDING NEW ORLEANS

Source I

Place	Number of Cases	
	Residents	Stricken
Ama	1	1
Amite	1	1
Alga	1	1
Arabi	1	0
Buras	1	0
Baton Rouge	1	1
Bogalusa	1	1
Covington	1	0
Chalmette	4	8
Delacrox I.	1	1
Destrahan	1	1
Gretna	3	1
Hammond	1	0
Harvey	2	1
Jefferson Parish	1	2
Kenner	3	1
Marrero	2	2
Metaire	5	4
Morgan City	1	1
Ponchatoula	1	0
Poydras	1	0
Slidell	2	0
Springfield	1	0
St. Bernard	1	0
Sulfur	1	2
Westwego	3	3
Total Cases	42 ---	32

II. CASES FROM METROPOLITAN NEW ORLEANS

Residents of New Orleans	Stricken in New Orleans
113	138

CHART E

I. CASE LOCATIONS OUTSIDE LOUISIANA

Source I

State	Residence	Country	Residence
Alabama	2	Canada	1
Florida	1	France	1
Mississippi	1	Greece	1
Pennsylvania	1	Italy	1
Tennessee	1	Latin America	2
Texas	1	Norway	2
Wisconsin	1	Turkey	1
Total	8		9

II. CASE LOCATION SUMMARY

Source I

Place	Case Residence	Case Stricken
New Orleans	113	138
Louisiana - Other Than New Orleans	43	33
States Other Than Louisiana	8	2
Countries Other Than USA	9	1*
Not Stated	1	1
Total	174	174

*Stricken on board French Liner

90% of cases were residents of Louisiana

65% of these cases were residents of New Orleans

CHART F

CASES EACH YEAR OVER SPAN 1934-1962 (INCLUSIVE)

Source I

Year	No. of Cases	Year	No. of Cases
1934	2	1949	3
1935	0	1950	4
1936	4	1951	14
1937	0	1952	9
1938	5	1953	10
1939	3	1954	15
1940	2	1955	7
1941	1	1956	5
1942	4	1957	13
1943	3	1958	8
1944	1	1959	13
1945	5	1960	13
1946	1	1961	8
1947	0	1962	16
1948	4		

Total Cases 174

CHART G

TOTAL NUMBER OF CASES BY CALENDAR MONTHS
SPAN OF YEARS 1934 - 1962 (INCLUSIVE)

Source I

Month	No. of Cases	Month	No. of Cases
January	1	July	56
February	2	August	43
March	2	September	20
April	1	October	4
May	10	November	0
June	35	December	0

Total Cases 174

<u>Cases Occurring During Peak Heat Season</u>

154 or 88.5%: Total cases during four hottest months June, July, August, September.

134 or 77%: Total cases during June, July August.

2 Months: November and December had no cases over span of years 1934 - 1962.

CHART H

I. CASES BY MAXIMUM CLIMATIC TEMPERATURE RANGES AT PLACE STRICKEN

Source I

Maximum Temperature F.	No. of Cases	% of Cases
95^{o} and over	27	15.5
90^{o} to 95	101	58
85^{o} to 90	33	19
80^{o} to 85	7	4
80^{o} and below	6	3.5
Total	174	100

161, or 92.5% of the heat syndrome cases occurred on days having maximum temperature of 85^{o} F. and over.

II. CASES BY MAXIMUM RELATIVE HUMIDITY RANGES AT PLACE STRICKEN

Source I

Maximum Relative Humidity %	No. of Cases	% of Cases
95 and over	13	8.2
90 - 95	40	26.0
85 - 90	43	27.0
80 - 85	27	17.0
70 - 80	24	15.2
60 70	9	6.0
Below 60	1*	0.6
Total	157**	100.0

*This case had previous heat attack. Chief engineer on ship when stricken in June. Climatic maximum temperature for date 91^{o} F., and maximum relative humidity for date 51%.

**157 cases with climatic data given.

Air temperatures for association with the humidity readings are not available from Source I data.

CHART H-II indicates only whether the air was relatively dry or moist.

CHART I

HEAT SYNDROME CATEGORIES
CASES IN EACH

Source I

	Heat Cramps	Heat Prostration	Heat Stroke	Totals by Sex	% of Totals by Sex
Male Female	10 1	123 14	22 2	155 17	90 10
Totals by Category	11	137	24	172	100
% of Totals by Category	6	80	14	---	100

Total for this Chart is 172. Category for 2 of 174 unknown.

Comparatively few heat cramp cases are hospitalized.

CHART J

INDIVIDUAL HEAT SYNDROME CASE AND TREATMENT CHART

Source I

Case No.	Days Hospitalized			Past Hx*	Sun Exposure and/or Physical Exertion		I. V.** Therapy Given
	No Days	More than 2	4 or More		Yes	No.	
1	2				x		x
2	4		x		x		
3	1/2					x	
4	1					x	
5	2					x	
6	-						
7	5		x	x	x		
8	1				x		x
9	2				x		
10	1				x		
11	1				x		
12	6		x		x		
13	2				x		
14	2			x	x		
15	4		x	x	x		
16	1				x		x
17	2				x		
18	14		x			x	x
19	5		x		x		
20	2			x	x		x
21	1				x		
22	1/2				x		
23	4		x		x		x
24	2				x		
25	1				x		x
26	3	x			x		x
27	1				x		x
28	1				x		x
29	3	x			x		
30	2				x		x
31	4		x		x		
32	2			x	x		
33	1				x		x
34	2			x		x	
35	3	x			x		
36	2			x	x		x

*Past history

**Intravenous

CHART J

INDIVIDUAL HEAT SYNDROME CASE AND TREATMENT CHART (cont'd)

Source I

Case No.	Days Hospitalized			Past Hx	Sun Exposure and /or Physical Exertion		I. V. Therapy Given
	No. Days	More than 2	4 or More		Yes	No.	
37	3	x			x		
38	1				x		
39	9		x	x	x		
40	3	x			x		
41	1			x	x		
42	2				x		x
43	3	x		x	x		
44	3	x			x		
45	2			x	x		
46	2			x	x		
47	3	x			x		
48	1				x		x
49	2				x		
50	2				x		
51	2				x		
52	3	x			x		
53	*			x	x		
54	1				x		x
55	10		x	x	0*		
56	3	x		x	x		x
57	3	x			x		x
58	2				x		x
59	2				x		x
60	3	x			x		x
61	1				x		x
62	1				x		x
63	9		x	x	0*		x
64	5		x		x		x
65	2			x	x		
66	1/2				x		x
67	4		x			x	x
68	2			x	x		x
69	5		x	x	x		x
70	*						
71	15		x		0		
72	1/2			x	x		x

*not known

CHART J

INDIVIDUAL HEAT SYNDROME CASE AND TREATMENT CHART (cont

Source I

Case No.	Days Hospitalized No. Days	More than 2	4 or More	Past Hx	Sun Exposure and/or Physical Exertion Yes	No.	I. V. Therapy Given
73	1				x		x
74	1				x		x
75	1				0		x
76	1				x		x
77	5		x		x		x
78	4		x	x	x		x
79	1				x		x
80	1/2				x		x
81	1				x		x
82	4		x		x		x
83	1			x	x		x
84	*						
85	1/2				x		
86	2				x		
87	3	x			x		x
88	*						
89	5		x		x		x
90	1				x		x
91	2				x		x
92	1				x		x
93	1/2				x		
94	1				x		x
95	2				x		x
96	2			x	x		x
97	2				x		x
98	1				x		x
99	1				x		x
100	2				x		x
101	4		x		x		x
102	2			x	x		x
103	2				x		x
104	3	x			0*		x
105	3	x			x		
106	10		x		x		x
107	9		x		x		
108	2				x		x
109	2				x		x
110	7		x			x	x

*not known

CHART J

INDIVIDUAL HEAT SYNDROME CASE AND TREATMENT CHART (cont'd)

Source I

Case No.	Days Hospitalized No. Days	Days Hospitalized More than 2	Days Hospitalized 4 or More	Past Hx	Sun Exposure and/or Physical Exertion Yes	Sun Exposure and/or Physical Exertion No	I. V. Therapy Given
111	*						
112	6		x		x		x
113	1				x		x
114	2				x		x
115	1				x		x
116	2				x		
117	3	x		x	x		x
118	*						
119	3	x			x		x
120	1				x		x
121	3	x			x		x
122	2				x		x
123	9		x	x	x		x
124	2				x		x
125	3	x			x		
126	2				x		
127	3	x			x		x
128	6		x		x		
129	1				x		x
130	3	x		x	x		x
131	2			x			x
132	8						
133	2				x		x
134	8		x	x	x		x
135	4		x		x		x
136	3	x				x	x
137	2				x		x
138	*						
139	1/2				x		
140	6		x		x		x
141	1			x	x		
142	1/2				x		x
143	3	x			x		x
144	2				x		x

*not known

CHART J

INDIVIDUAL HEAT SYNDROME CASE AND TREATMENT CHART (cont'd)

Source I

Case No.	Days Hospitalized			Past Hx	Sun Exposure and/or Physical Exertion		I. V. Therapy Given
	No. Days	More than 2	4 or More		Yes	No.	
145	7		x		x		x
146	2				x		x
147	2				x		x
148	1					x	
149	3	x			x		
150	2				x		x
151	2				x		
152	2				x		x
153	1/2				x		
154	4		x		x		x
155	2				x		x
156	*					x	
157	6		x		x		
158	*				x		x
159	*				x		
160	*		x		0*		x
161	*				x		
162	8				x		x
163	*				x		x
164	1				x		x
165	2				x		x
166	1/2			x	x		x
167	1				x		x
168	*				x		x
169	1				x		x
170	1					x	x
171	1				x		x
172	1				x		x
173	1				x		x
174	2				x		x
175	3	x			0*		
176	1				x		x
177	2				x		

*not known

CHART J

INDIVIDUAL HEAT SYNDROME CASE AND TREATMENT CHART (cont'd)

Source I

Case No.	Days Hospitalized: No. Days	Days Hospitalized: More than 2	Days Hospitalized: 4 or More	Past Hx	Sun Exposure and/or Physical Exertion: Yes	Sun Exposure and/or Physical Exertion: No	I. V. Therapy Given
178	4		x		x		
179	1/2			x		x	x
180	6		x		0		x
181	7		x		x		x
182	4		x		x		x

The discharge diagnosis discounted or denied heat syndrome in eight of these 182 cases. Therefore, the total used in Source I is 174 cases.

CHART K

DEATHS

DATE- AGE- RACE - SEX

Source I

Year	Mo.	Case No.	Age	Race/Sex	Activity at Time of Death
1936	July	#142	62	WM	Fishing in sun all day.
1954	June	# 93	40	WM	Worked in closed room all day - wall papering.
1954	July	#105	79	WM	Walked in sun, fell unconscious.
1954	July	#107	50	WM	At work, occupation, insulator.

Total: 4 deaths - WM

4 or 2.4% of total cases (170) expired.
40 - 79 years: Age range of deaths.
57 years : Average age of deaths.
155 or 90% total (170) M. - 17 or 10% F.
4 or 100% M : All WM.

2 Outdoor activity - 79 of total (159) activity known, stricken outdoors.
2 Indoor activity - 80 of total (159) activity known, stricken indoors.
3 of 4 deaths occurred June and July 1954.

CHART L

CASES BY AGE GROUP, RACE, AND SEX

Source II

Age Group	WM	WF	CM	(	Totals By Age Group
Under 1 Yr.	0	0	1	1	2
1 - 10	1	0	1	0	2
11 - 20	4	1	1	0	6
21 - 25	4	1	5	0	10
26 - 30	0	1	8	0	9
31 - 35	0	0	3	1	4
36 - 40	1	0	4	1	6
41 - 45	3	0	4	0	7
46 - 50	3	2	3	1	9
51 - 55	7	0	1	2	10
56 - 60	2	1	3	1	7
61 - 66	2	2	3	1	8
66 - 70	5	0	1	1	7
71 - 75	2	1	0	0	3
76 - 80	2	0	0	0	2
81 - 85	0	2	0	0	2
86 - Over	0	2	0	0	2
Not Known	-	-	-	-	1
Totals: Race/Sex	37	11	38	9	96-1=95

Overall age range: 13 Days - 94 Years
Male age range : 13 Days - 94 Years
Female age range : 9 Months - 85 Years

75 - 79% Total M
20 - 21% Total F
48 - 50.5% Total W
47 - 49.5% Total C

37 - 39% Total WM
38 - 40% Total CM
11 - 11.6% Total WF
9 - 9.4% Total CF

61 - 64% Total cases (95) are in 11 - 55 year span.
51 - 83.6% Total(61) are males in 11 - 55 year span.
10 - 16.4% Total(61) are females in 11 - 55 year span.

CHART M

HEAT SYNDROME CASES - 1942 - 1963

Source II

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Totals By Yr.
	Number of Cases by Each Month												
1942	0	0	2	1	0	3	1	1	1	0	0	0	9
1943	0	0	0	0	1	0	4	0	1	1	0	0	7
1944	0	0	0	0	1	14	0	0	0	1	0	0	16
1945	0	0	0	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	0	0	0	0
1947	0	0	0	0	0	0	0	0	0	0	0	0	0
1948	0	0	0	0	0	0	4	1	1	0	0	0	6
1949	0	0	0	0	0	0	0	0	0	0	0	0	0
1950	0	1	0	0	0	1	0	0	0	0	0	0	2
1951	0	0	1	2	0	1	6	6	2	1	0	0	19
1952	0	0	0	0	0	2	2	1	0	0	0	1	6
1953	0	0	0	0	0	3	3	0	1	0	0	0	7
1954	0	0	0	0	0	1	4	2	0	0	0	0	7
1955	0	0	0	0	0	0	1	3	0	0	0	0	4
1956	0	0	0	0	0	1	0	0	0	0	0	0	1
1957	0	0	0	0	0	0	1	1	0	0	0	0	2
1958	0	0	0	0	0	0	0	1	0	0	0	0	1
1959	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	0	0	0	0	1	2	0	0	0	0	0	3
1961	0	0	0	0	0	1	0	0	0	0	0	1	2
1962	0	0	0	0	0	0	0	1	1	0	0	0	2
1963	0	0	0	0	0	1	0	0	0	0	0	0	1
Totals By Mo.	0	1	3	3	2	29	28	17	7	3	0	2	95

No cases recorded for the years: 1945, 1946, 1947, 1949, and 1959.

No cases recorded for the months: January and November.

CHART N

TOTAL NUMBER OF CASES BY CALENDAR MONTHS
SPAN OF YEARS 1942 - 1963 (INCLUSIVE)

Source II

Month	No. of Cases	Month	No. of Cases
January	0	July	28
February	1	August	17
March	3	September	7
April	3	October	3
May	2	November	0
June	29	December	2

Total Cases 95

Cases Occurring During Peak Heat Season

81 or 85%: Total cases during four hottest months - June, July, August, September.

74 or 78%: Total cases during June, July August.

2 Months: January and November had no cases over span of years 1942 - 1963.

CHART O

DEATHS

YEAR - AGE - RACE - SEX

Source II

Year	Month/Date	Age	Race/Sex
1942	No deaths		
1943	7/26	52	WM
1944	6/25	85	WF
1944	6/24	59	WF
1944	6/29	84	WF
1944	6/23	68	WM
1944	6/21	7	WM
1944	6/21	60	CM
1945	No cases		
1946	No cases		
1947	No cases		
1948	No deaths		
1949	No cases		
1950	No deaths		
1951	7/27	45	WM
1951	8/11	54	WM
1951	8/14	41	WM
1951	7/24	75	WF
1952	No deaths		
1953	No deaths		
1954	7/1	47	CM
1954	7/1	64	CM
1955	No deaths		
1956	No deaths		
1957	No deaths		
1958	No deaths		
1959	No cases		
1960	7/24	54	CF
1961	No deaths		
1962	9/14	52	WM
1963	No deaths		

CHART P

DEATHS

YEAR - AGE - RACE - SEX

Year	Mo.	Age	Race	Sex	Year	Mo.	Age	Race	Sex
1943	July	52	W	M	1951	July	45	W	M
1944	June	85	W	F	1951	Aug.	54	W	M
1944	June	59	W	F	1951	Aug.	41	W	M
1944	June	84	W	F	1951	July	75	W	F
1944	June	68	W	M	1954	July	47	C	M
1944	June	7	W	M	1954	July	64	C	M
1944	June	60	C	M	1960	July	54	C	F
					1962	Sept.	52	W	M

Totals: 15 deaths - 10 M - 5 F - 11 W - 4 C
7 WM - 4 WF - 3 CM - 1 CF

15 or 16% of total cases (95) expired.
7 - 85 years : Age range of deaths.
56.5 years : Average age of deaths.

10 or 66.7%	:	M.	7 or 46.6%	:	WM.
5 or 33.3%	:	F	4 or 26.7%	:	WF.
11 or 73%	:	W.	3 or 20%	:	CM.
4 or 26.7%	:	C.	1 or 6.7%	:	CF.

6 or 40% of 15 deaths (in 29 years) - June 1944.
2 or 13.3% of 15 deaths(in 29 years)- July 1954.
2 or 13.3% of 15 deaths(in 29 years)- July 1951.
2 or 13.3% of 15 deaths(in 29 years)- Aug. 1951.
4 or 26.7% of 15 deaths(in 29 years)- Year 1951.
July 1943, July 1960, September 1962 - 1 death each.
All deaths in June, July, August, and September.

CHART Q
DEATHS

COMPARISON OF SOURCES I AND II

Source I	Source II
Total cases: 170	Total cases: 95
Deaths : 4	Deaths : 15
Crude death rate: 2.4%	Crude death rate: 16%
Av. age deaths: 57 yrs.	Av. age deaths· 56.5 yrs.
155 or 91% total(170): M	75 or 79% total(95): M
17 or 10% total(170) : F	20 or 21% total(95): F
4 or 100% deaths : M	10 or 66.7% deaths: M
No female deaths	5 or 33.3% deaths : F
4 or 100% deaths: June, July	5 or 33.3% deaths: June, July
3 or 75% (4) deaths: 1954	2 or 13.3%(15) deaths: 1954
Span of yrs.: 1934-1962(29)	Span of yrs.: 1952-1963(22)

Race factor not included on this chart because Source I had only 7 non-white cases.

CHART R

COMPARISON OF CASES BY YEARS
1942 - 1962 (INCLUSIVE)

Sources I and II

Year	Number of Cases		Yearly Total
	Source I	Source II	Sources I and II
1942	4	9	13
1943	3	7	10
1944	1	16	17
1945	5	0	5
1946	1	0	1
1947	0	0	0
1948	4	6	10
1949	3	0	3
1950	4	2	6
1951	14	19	33
1952	9	6	15
1953	10	7	17
1954	15	7	22
1955	7	4	11
1956	5	1	6
1957	13	2	15
1958	8	1	9
1959	13	0	13
1960	13	3	16
1961	8	2	10
1962	16	2	18
Totals	156	94	250

156 or 62.4%: Total cases Source I (9 hospitals)
94 or 37.6% : Total cases Source II (1 hospital)
1947 : Only year (1942-1962) no cases either source.

1951, 1952, 1953, 1954: Heavy case-load years for Sources I and II.

87 or 35% : Total cases (250 in 21 yrs.) in four years.
Same peak-case years appear in other charts.

1942-1962 span - common to Sources I and II.

APPENDIX 1

SOURCE III

This Appendix contains the summary and detailed data of fatal heat syndrome cases from the New Orleans Coroner's Office from 1954-1962, inclusive.

The accompanying chart tabulates all factors available from this study.

NEW ORLEANS CORONER'S OFFICE STUDY

Source III

A special study was made of records at the coroner's office of New Orleans for the purpose of adding to the heat syndrome case data researched at nine New Orleans hospitals. These data will be referred to as Source III, Appendix 1.

Seven deaths from heat syndrome, none of which had been hospitalized, were recorded for the years 1954-1962, inclusive; three in 1954, one in 1955, and three in 1962. These deaths all occurred in three peak-heat months, July, August, and September.

A clinical diagnosis recorded for each of five cases identified two as heat exhaustion and three as heat stroke. No cases were identified as heat cramps, although two were not categorized but the cause of death was determined to have been effects of heat.

Only three cases had any past history or contributory causes noted. Two of these were obese and one had a pre-existing heart disease. Both of these conditions are conducive to an individual's succumbing at lower temperatures and with less physical exertion.

The ages were recorded for six cases and these ranged from 38 to 55 years, with an average age of 47 years. Six cases were recorded as males, and it has been assumed that the seventh case was also male.

There are several factors in the data from the coroner's records, Source III, that are comparable to the data from Sources I and II, previously analyzed in this report.

For Source I, 1954 and 1952 were the two peak years for heat syndrome cases in the span 1934-1962. These two years were also highest in cases from combined Sources I and II data for the years 1942-1962. Three of the peak-case months of Sources I and II were also reflected in the three months in which the Source III deaths occurred, namely, July, August, and September.

There were four deaths from Source I and three of those were in 1954, whereas from Source II neither 1954 nor 1962 were peak years for the 15 deaths. However, 1954 was a peak year for cases in Source II. Three of 7 deaths in Source III occurred in the "heat syndrome year" 1954.

DEATHS

1954-1962

SOURCE III

Year	Month/Day	Time	Race	Sex	Age	Past Hx1/	Clin. Dx2/
1962	Sept 14	3:40 p.m.	W	M	50	--	Heat Stroke
1962	Aug 28	6:25 p.m.	W	M	55	--	Heat Exhaustion
1962	--	--	C	M	--	Obese, 5'9" 200 lbs.	--
1954	--	--	C	M	41	--	--
1954	Jul 17	11 a.m.	--	M3/	54	Pre-existing Heart Disease	Heat Stroke
1954	Jul 2	11 a.m.	C	M	43	Obese, 5'5" 188 lbs.	Heat Stroke
1955	Jul 22	10 a.m.	C		38	--	Heat Exhaustion

1/ Past History
2/ Clinical Diagnosis
3/ It was assumed that this individual was male

Age Range: 38-55 years
Average Age: 47 years
3 or 43% of 7 coroner's cases in 1954
3 or 43% of 7 coroner's cases in 1962
1954-1962 inclusive, 7 year span

APPENDIX 2

SOURCE IV

This Appendix contains the summary and detailed data of "heat injuries" hospitalized in Army Medical Treatment Facilities in Zone of Interior, Department of the Army during 1961 and 1962.

The two accompanying charts tabulate all factors available from this report.

HEAT INJURIES - ARMY MEDICAL TREATMENT FACILITIES

ZONE OF INTERIOR, DEPARTMENT OF ARMY

Source IV

The data on heat syndrome cases in this Appendix were tabulated from monthly summary statistical reports forwarded by Army Medical Treatment Facilities in Zone of Interior to Office of The Surgeon General, Department of the Army.

In transferring these requested data it was emphasized that they were the best information available at time of reporting, though all cases might not be in complete agreement when professionally re-viewed clinical records are submitted.

All cases are reported under the generic term "heat injuries", including those diagnosed as heat cramps, heat prostration, or sunstroke. Cases treated solely as outpatients have been excluded.

For the purpose of this study the data have been tabulated and are presented here as probable additional evidence regarding the effects of the environmental situation, climate and weather, on man.

The "all patients" data were used instead of "active military patients only" in order to have the findings more comparable to other studies analyzed for this heat syndrome study. "All patients" figures include; Army, Navy, Marine Corps, and Air Force personnel on active duty, military personnel on active duty for training, retired personnel, allied and neutral military personnel, as well as all cases among dependents.

These cases were all treated at Army Medical Treatment Facilities in the Zone of the Interior, which includes the 48 contiguous States and the District of Columbia.

To determine whether or not these data would show any substantial difference between the number of heat syndrome cases reported from medical facilities located in the hot area and those in the more temperate area, a division was made according to a particular United States Weather Bureau chart. The climatological data for the areas having a mean annual of 60 days with maximum temperature 90°F. and above have been used to separate the hot and the temperate States in this analysis, though such divisions do not occur on State boundaries and mountain terrain, canyons, exposed coastal areas, and other variations which cause sharp changes within climatic zones.

The statistical chart for Appendix 2 shows the cases for the years 1961 and 1962 by month, temperate zone, hot zone, and the totals for the two years are tabulated under the same headings.

The calculations again show a preponderance of cases in the hotter climate, with a large majority of all the cases occurring in the four peak-heat months of June, July, August and September in both the hot and temperate zones.

In these factors, the only ones available for comparison to Sources I and II, the effects of climatic heat on man and the resultant marked increase in hospitalized heat syndrome cases are indeed evident in the tabulated statistics.

STATES HAVING ARMY MEDICAL TREATMENT FACILITIES

ZONE OF INTERIOR, DEPARTMENT OF THE ARMY

Source IV

Temperate Zone	Hot Zone
Illinois	Alabama
Kansas	Arizona
Kentucky	Arkansas
Maryland	California
Massachusetts	Georgia
Missouri	Louisiana
New Jersey	New Mexico
New York	North Carolina
Ohio	Oklahoma
Pennsylvania	South Carolina
Utah	Texas
Virginia	
Washington	
Wisconsin	

Zone of Interior: 48 contiguous States and the District of Colunbia
Temperate Zone: States in climatic area having less than a mean annual of 60 days with 90°F.
Hot Zone: States in climatic area having a mean annual of 60 days with 90°F.

Source: U.S. Department of Commerce Weather Bureau map, Mean Annual Number of Days Maximum Temperature 90°F. and Above, Except 70°F. and Above in Alaska Edition of 1961 - Base Map

HEAT INJURIES - ARMY MEDICAL TREATMENT FACILITIES

ZONE OF INTERIOR, DEPARTMENT OF THE ARMY

Source IV

	1961			1962			1961 & 1962
Month	All Cases	Temp. Zone	Hot Zone	All Cases	Temp. Zone	Hot Zone	Totals By Months
Jan	0	0	0	1	0	1	1
Feb	0	0	0	3	0	3	3
Mar	1	0	1	1	0	1	2
Apr	4	0	4	5	1	4	9
May	7	0	7	17	4	13	24
Jun	26	16	10	36	14	22	62
Jul	172	57	115	76	12	64	248
Aug	79	26	53	41	25	16	120
Sep	14	7	7	23	3	20	37
Oct	7	1	6	2	1	1	9
Nov	0	0	0	2	0	2	2
Dec	5	3	2	0	0	0	5
Totals by Years	315	110	205	207	60	147	522

110 or 35% total cases 1961 in temperate zone
205 or 65% total cases 1961 in hot zone
291 or 92.4% total cases 1961 in 4 peak-heat months
106 or 36.4% of 291 in temperate zone in 4 peak-heat months
185 or 63.6% of the 291 in the hot zone in 4 peak-heat months
60 or 29% total cases 1962 in temperate zone
147 or 71% total cases 1962 in hot zone
176 or 85% total 207 cases 1962 in 4 peak-heat months
54 or 30.7% of the 176 in temperate zone in 4 peak-heat months
1[illegible]2 or 69.3% of the 176 in hot zone in 4 peak-heat months
[illegible]2 or 67.4% of total cases for two years (522) in the hot zone
462 or 89.5% of total cases for two years in 4 peak-heat months

APPENDIX 3

This Appendix is a survey and analysis of the clinical records of heat syndrome cases at Louisiana State Charity Hospital from 1942-1946 inclusive. It was prepared as a thesis by Kenneth Michael Laughlin, B.S., M.D., under the title, Study of Heat Stress Disorders in New Orleans, and was submitted as a part of this study by Drs. George E. Burch and Nicholas P. DePasquale of Tulane University, School of Medicine, New Orleans, Louisiana.

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A STUDY OF HEAT STRESS DISORDERS

IN NEW ORLEANS

BY

Kenneth Michael Laughlin

Received by the Division
of Health Mobilization
from School of Medicine,
Tulane University,
New Orleans, Louisiana,
June 1965

ABSTRACT

This study of heat stress disorders in New Orleans was undertaken in effort to determine the factors which contribute to the failure of man's thermoregulatory mechanisms. The cases studied revealed that the following factors were related, to a greater or lesser degree, to the precipitation of heat stress disorder: meteorologic conditions, activity, environment, underlying disease and age.

INTRODUCTION

During the Second World War several extensive research programs were developed in this country for the study of the influence of thermal stress on man. Since the end of the war there has been little research activity in human bioclimatology. However, in the last few years there has been a revival of interest in the study of the relationship of man to his environment, particularly in regards to the limits of thermal tolerance and how these limits may be extended. This recent interest in human climatology has been an outgrowth of the space program as well as a result of the concern of such agencies as the Public Health Service with problems of thermal stress in air raid and fall-out shelters, particularly under conditions of overcrowding.

A most fruitful method of studying the influence of thermal stress on man is to investigate instances in which the adaptative mechanisms fail in acclimatized man. Such a study would help to provide answers to two of the most vital questions related to human thermal stress situations, namely, under what conditions and why do the thermal regulatory mechanisms fail. No laboratory animal can serve as a model for man because man's thermal regulatory mechanisms are unique. Furthermore, if man is used as the experimental animal, it would be difficult to design a satisfactory experiment which would answer the questions indicated above. One means of determining the limits of heat stress in man is to study patients in whom thermoregulatory difficulties develop during the course of their daily activity.

In order to learn more about the conditions under which problems with thermal regulation develop in man the clinical records of patients admitted to the Charity Hospital in New Orleans with a diagnosis of heat stroke or heat exhaustion were studied. It is recognized that only the more seriously ill patients are admitted to the hospital and that patients with less serious disease (heat asthenia or heat cramps) are seldom hospitalized.

MATERIALS AND METHODS

The records of all adults admitted to the Charity Hospital in New Orleans from (1942 to 1964) inclusive with a diagnosis of heat stroke or heat exhaustion were studied. Because thermoregulatory problems are different in infants and children only the records of adult patients were studied.

Climatological conditions for the week prior to the onset of symptoms were studied with respect to average daily temperature, maximum daily temperature, maximum daily relative humidity, and departure from normal mean daily temperature for each patient. The climatological data were obtained from the daily records of the Station Meteorological Surveys of the United States Department of Commerce Weather Bureau. All temperatures and relative humidities were recorded at Moisant International Airport, New Orleans, Louisiana.

RESULTS

Age, Sex and Race: The patients varied from 17 to 95 years of age. Although the largest group of patients was between 21 and 30 years of age the majority of the patients were rather evenly distributed between 21 and 70 years of age (Fig. 1). Only 7 patients were more than 70 years of age. Fifty-eight (82%) were male and 13 (18%) were female. Thirty-seven (52%) patients were Negro, 33 (46%) were Caucasian and one patient was Oriental.

Activity at the Time of Onset of Symptoms: The activity of the 71 patients at the time of onset of symptoms was divided into the four following categories:

1) markedly active, to include such activities as heavy labor or running,
2) Moderately active, to include such activities as walking or working as a clerk,
3) no activity (resting or sleeping), and
4) no mention of activity.

According to the above, 51% of the patients were markedly active, 23% moderately active, 13% inactive and in 13% of patients no statement of activity was mentioned in the chart.

Local Environmental Conditions at the Time of Onset of Symptoms: Of the 71 patients 7% were in a closed space with little ventilation, 23% were indoors but not confined to a closed or poorly ventilated space, and 59% were out-of-doors in the open air at the time of onset of symptoms. In 11% of patients no mention of local environmental conditions was found.

Meteorological Conditions Prior to the Onset of Symptoms: Meteorological conditions prior to onset of symptoms were analyzed for 60 of the 71 patients. In 11 patients symptoms developed in localities for which no meteorological data was available.

The mean average temperature for the week prior to the onset of symptoms was 81.8°F (mean maximum 90.5°F) whereas the mean maximum relative humidity was 91.5%. The average departure from the mean temperature for the week prior to the onset of symptoms was 3.4°F higher than normal.

Clinical Picture: The 71 patients were divided into three of the four heat disease syndromes as outlined by Burch and DePasquale (1). These four syndromes include heat asthenia, heat cramps, heat exhaustion and heat stroke. No patients with heat asthenia were admitted to the hospital because of the mild nature of the syndrome. The distribution of the patients in the three remaining categories was as follows: heat cramps 17 (25%), heat exhaustion 35 (49%) and heat stroke 19 (27%).

The vital signs, clinical examination of the skin, and results of the cardiac examination are summarized in Tables 1-3.

Underlying Disease: In 40 patients there was no past history of significant disease. In the remaining 31 patients the following diseases were considered to be significant: hypertension, 7; heart disease (abnormal electrocardiogram), 3; syphilis, 4; rheumatic heart disease, 3; congestive heart failure, 2; previous cerebro-vascular accident, 2; emphysema, 2; pneumonitis, 2; peptic ulcer, 2; psychosis, 2; diabetes mellitus, 2; mental deficiency, 1; delirium tremens, 1; peripheral vascular disease and excessive vaginal bleeding 5 days prior to admission.

Laboratory Studies: Of the 71 patients, 43 had no laboratory studies performed on admission. The average blood sugar level for 24 patients was 155 milligrams per cent. The average blood urea nitrogen for 25 patients was 24.8 milligrams per cent. The average carbon dioxide combining power for 19 patients was 29.1 milli-equivalents per liter. The average serum chlorides for 7 patients was 101.8 milliequivalents per liter.

Electrocardiograms, when available, were reviewed with respect to those taken sometime before the onset of symptoms, to those taken on admission, and to those taken sometime after the patient was discharged from the hospital.

Of the 6 patients who had electrocardiograms taken before admission, 3 were within normal limits and 3 showed evidence of myocardial disease.

Electrocardiograms were recorded on admission in 26 patients. Eleven were within normal limits and 14 showed evidence of myocardial disease.

Electrocardiograms of 17 of the patients recorded sometime after discharge revealed that 9 were within normal limits and 8 had evidence of myocardial disease.

Of the 71 patients, roentgenograms were obtained on admission in 17. The roentgenogram was normal in 10 patients. The positive findings present in the other patients were: pneumonitis, 3; prominent vascular markings, 2; cardiac enlargement, 1; generalized fibrotic infiltration, 1; pleural reaction, 1; and aneurysm of descending aorta, 1.

Therapy: Fifty-six (80%) patients received parenteral fluid therapy. The following fluids were administered: normal saline alone, 21; 5% dextrose in water alone, 3; 5% dextrose in normal saline alone, 15; normal saline and 5% dextrose in water, 5; normal saline and 5% dextrose in normal saline, 4; 5% dextrose in water and 5% dextrose in normal saline, 4; normal saline, 5% dextrose in water and 5% dextrose in normal saline, 3; normal saline plus sodium lactate, 1. Other fluids received were whole blood, 6; 3% saline, 1; and dextran, 1.

Forty-one (56.3%) of the 71 patients received supportive therapy as follows: forced fluids, 19; ice packs, 18; antipyretics, 9; ice water enemas, 3.

Other drugs used were antimicrobials, 17; sedatives, 10; analgesics, 9; cardiac drugs, 7; bronchodilators, 5; salt tablets, 6; anticonvulsive drugs, 4; hypertensive drugs, 4; steroids, 3; muscle relaxants, 1; diuretics, 1; and miscellaneous, 11.

Outcome: Of the 71 patients, 3 deserted within 24 hours after admission and 28 patients were discharged soon after admission either markedly improved or cured. Forty patients remained in the hospital from 2 to 28 days (average 6.1). Of these 40 patients 13 died. The autopsy finding in these 13 patients was as follows: cardiac disease, 11; pulmonary disease, 10; vascular disease, 6; encephalopathy, 3; renal disease, 3; hepatic disease, 1; retroperitoneal hematoma, 1.

DISCU. SION

From this study, it appears that a multiplicity of factors are associated with the failure of man's thermoregulatory mechanisms.

It seems that age plays a role as the majority of patients affected were rather evenly distributed between 21 and 70 years of age. It is interesting that there is a sudden drop-off in the age distribution of those affected at age 70. This could possibly be associated with some metabolic changes which occur with advanced age, or due to the decreased activity of elderly people, as none of the 7 patients 71 years of age or older was markedly active at the time of onset of symptoms. It could also be a reflection of a small elderly population.

Sex as an influencing factor cannot be adequately evaluated due to the major disparity of the activities of male and female at the time of onset of symptoms.

Race seems to play no role as the ratio of Caucasian to Negro was roughly 1: 1.

Activity seems to be a major factor in most of the patients, as over half of them were considered to be markedly active. This probably contributed substantially to the excess water and electrolyte depletion which preceded the onset of symptoms.

Only 13% were inactive at the time of onset of symptoms indicating that some other factors besides increased activity were at work. It was found, for example, that the average departure from the mean daily temperature was greater than $8^{o}F$ above normal for the inactive patients. Four of the inactive patients had been in an enclosed, poorly ventilated space and all had experienced heat stroke. Thus, it can be seen that a hot, poorly ventilated, closed space can be a factor in precipitating heat stroke.

Meteorological conditions prior to the onset of symptoms do play a role in the etiology of heat disease. In 75% of the instances of heat disease the temperature was higher than normal and the relative humidity was very high. In the 15 (25%) patients where the temperature was normal or less than normal for that time of year, there was only one case of heat stroke. This one case was a known diabetic and was thought to be in congestive heart failure on admission. diagnosis of heat exhaustion was made in 10 of these 15 patients, and 4 had a diagnosis of heat cramps. In these latter two groups there was a consistent history of heavy labor and much perspiring with little or no water and salt replacement.

The clinical picture of the patients admitted is best summarized in Tables 1-3, and needs no discussion.

The most significant underlying diseases present at the time of admission seemed to be associated with the cardiovascular system. This finding is also confirmed by the autopsy findings in the patients who died. Underlying disease in general seems to be a contributing factor to the precipitation of heat disease.

The laboratory findings cannot be considered to be really significant as too few patients had these procedures performed on them. It is of interest, however, that over half of the patients who had electrocardiograms on admission showed evidence of myocardial disease. Follow up electrocardiograms were not available on most of these patients, so residual cardiac damage could not be studied.

The therapy instituted in most of the patients was considered adequate. Where it was inadequate or incorrect, it seemed to be associated with an initially incorrect diagnosis.

TABLE 1

AVERAGE VITAL SIGNS ON ADMISSION

Syndrome	Heat cramps (17 patients)	Heat exhaustion (35 patients)	Heat stroke (19 patients)
Temperature (F^{o})	99.5	99.8	107.5
Blood pressure (mm. Hg)	134/89	102/57	115/59
Pulse	101	90	126
Respirations	22	25	35

TABLE II

PHYSICAL FINDINGS OF THE SKIN ON ADMISSION

Skin findings	Heat cramps (12 patients)	Heat exhaustion (14 patients)	Heat stroke (12 patients)
Red	4	0	2
Hot	3	3	9
Dry	2	4	9
Cold	1	4	0
Clammy	1	4	0
Perspiring	8	5	0
Decreased turgor	0	2	1
Rash	1	1	1

TABLE III

CLINICAL HEART CONDITION ON ADMISSION

Syndrome	Heat cramps (16 patients)	Heat exhaustion (30 patients)	Heat stroke (18 patients)
Within normal limits	12	22	12
Murmurs			
systolic	1	4	2
diastolic	0	0	1
Irregular rate	2	5	2
Cardiomegaly	0	1	3
Distant heart sounds	2	5	4

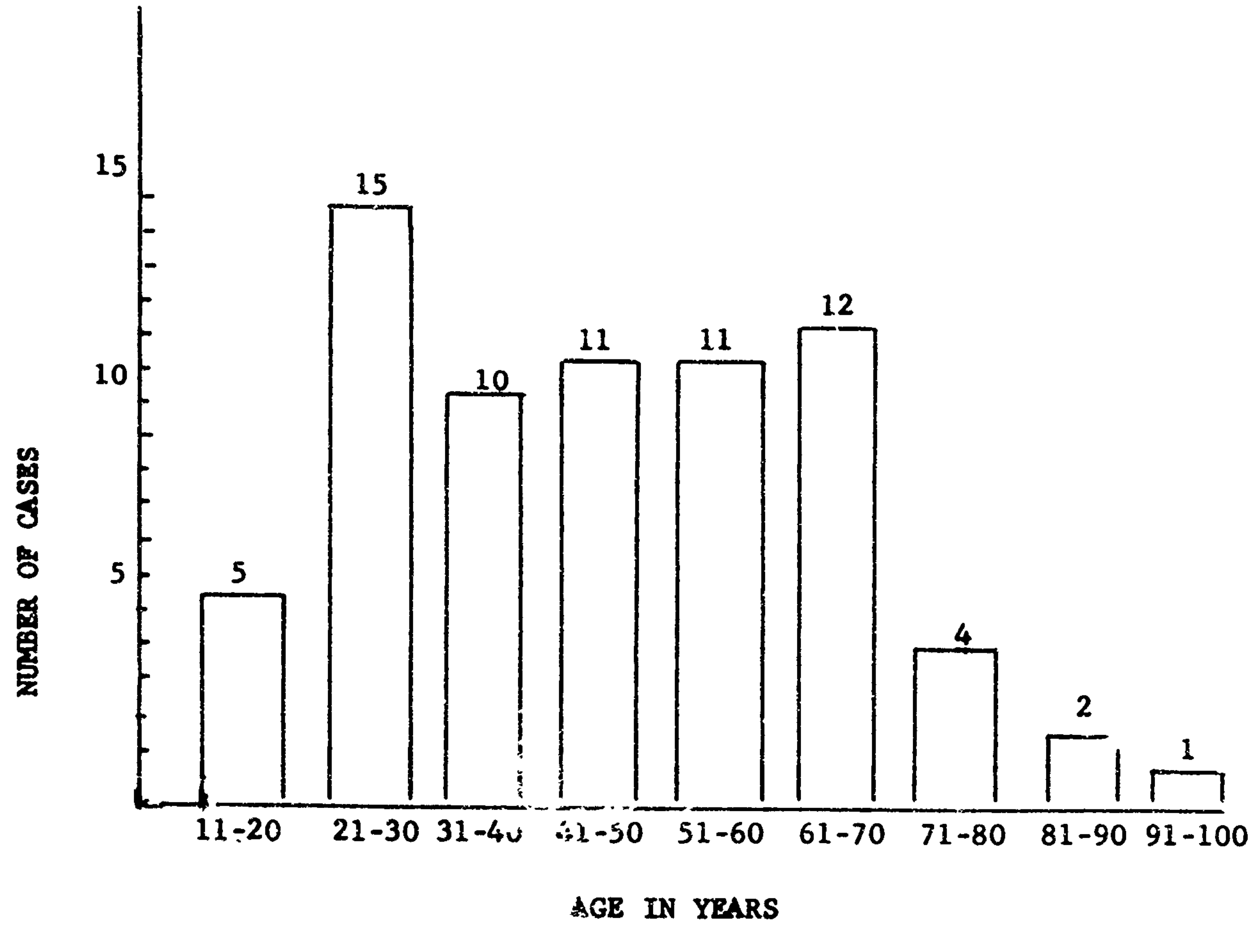

FIGURE 1: DISTRIBUTION OF CASES ACCORDING TO AGE

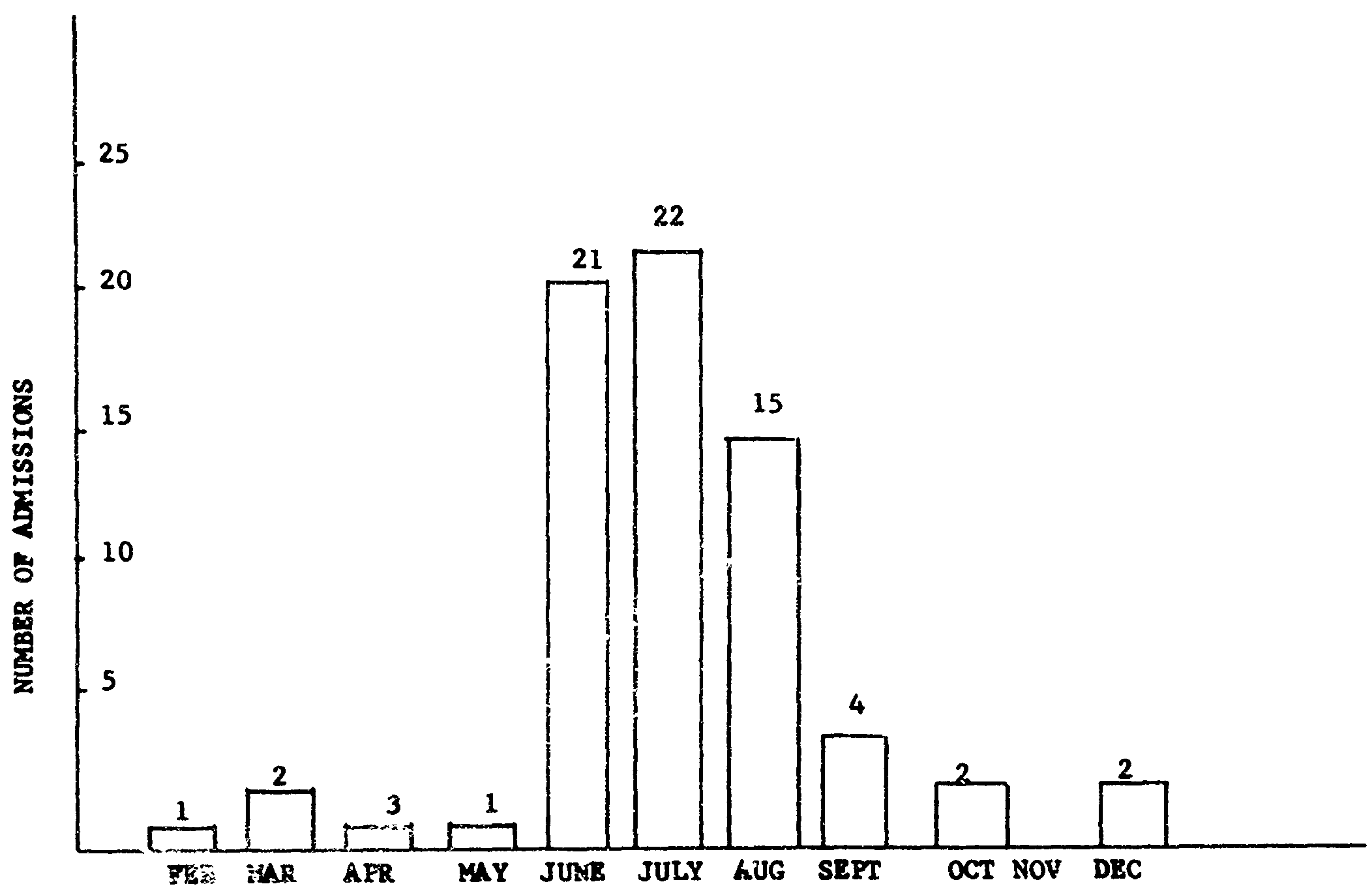

FIGURE 2: MONTH OF DATE OF ADMISSION

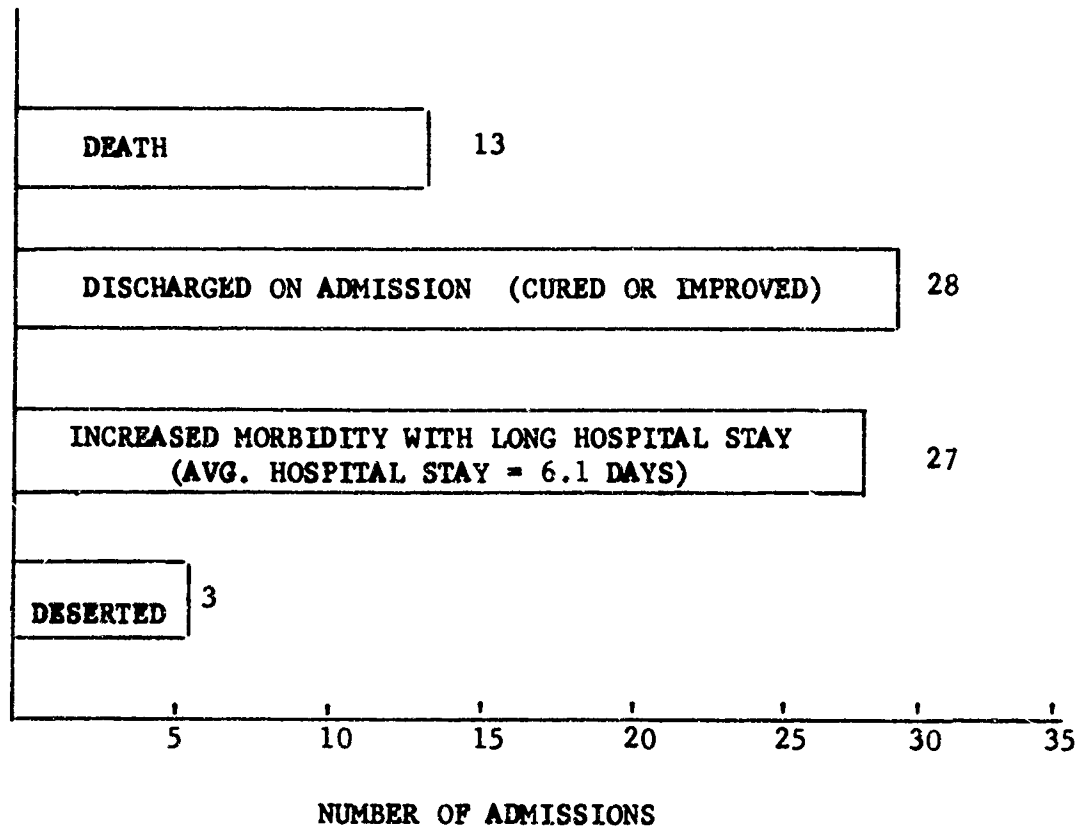

FIGURE 3: COURSE OF ILLNESS

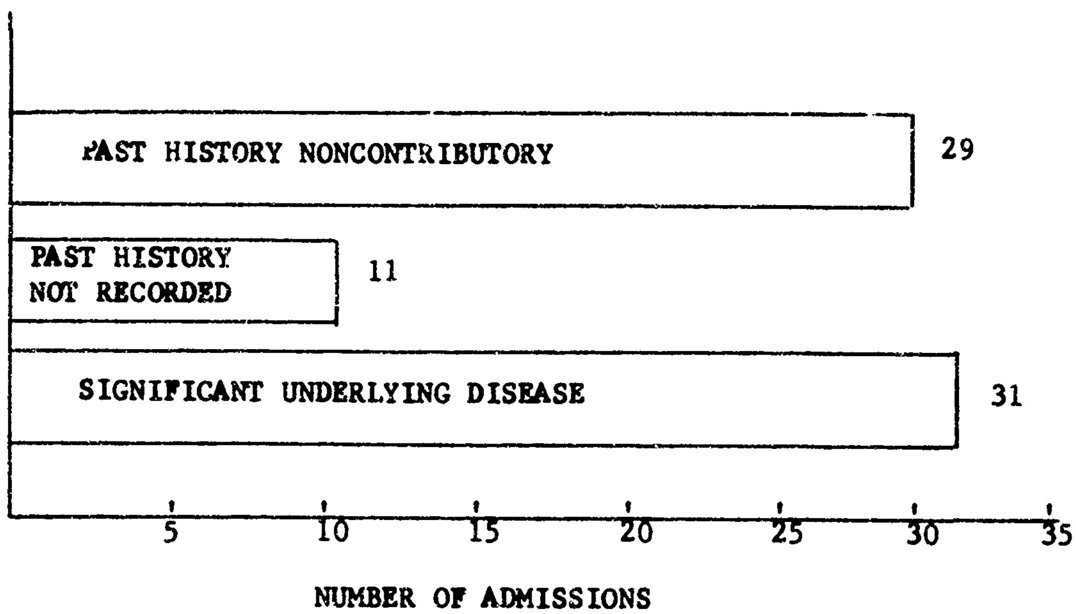

FIGURE 4: UNDERLYING DISEASE

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3 REPORT TITLE

HEAT SYNDROME DATA FROM SELECTED HOSPITAL RECORD SURVEY

4 DESCRIPTIVE NOTES (Type of report and inclusive dates)
Final Report

5 AUTHOR(S) (Last name, first name, initial)
Division of Health Mobilization
Project Officer - Paul S. Parrino, M.D., M.P.H.
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Hospital Record Survey
James Meyers, M.D. and
Mario A. Calonje, M.D.

6 REPORT DATE	7a TOTAL NO OF PAGES	7b NO OF REFS
December 1965	82	None

8a CONTRACT OR GRANT NO. OCD-OS-62-100	9a ORIGINATOR'S REPORT NUMBER(S) NA
b. PROJECT NO Subtask 1221A	
c NA	9b OTHER REPORT NO(S) (Any other numbers that may be assigned this report)
d NA	First Edition

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11 SUPPLEMENTARY NOTES	12 SPONSORING MILITARY ACTIVITY
None	Office of Civil Defense Department of Army Washington, D.C. 20310

13 ABSTRACT

Statistical analysis of heat syndrome causes, both environmental and human factors, with preventive and alleviating suggestions for civil defense shelters and similar situations. Useful base for clinical evaluation, for physicians and other medical personnel in emergency situations.

DD FORM 1 JAN 64 1473

Security Classification

Security Classification

14 KEY WORDS	LINK A ROLE	LINK A WT	LINK B ROLE	LINK B WT	LINK C ROLE	LINK C WT
MEDICAL PERSONNEL, SHELTER, HUMIDITY, CLIMATOLOGY, DISEASES, HEAT, ENVIRONMENT, STRESS, HOT ENVIRONMENTS, EPIDEMIOLOGY, AGING, CARDIOVASCULAR SYSTEM, SURVIVAL, TOLERANCES, PHYSIOLOGY, DISASTERS, HEALTH MOBILIZATION.						

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